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RACIAL DIFFERENCES IN THE PREDICTION OF CLASS "A" SCHOOL GRADES

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This study is the latest in a series of efforts to provide the educationally disadvantaged with an opportunity for technical training in a Navy rating. Based on the findings of a 1972 study, which concluded that the Navy's selection tests are not as valid for minority personnel as they are for the majority group, the utility of alternative test composites was investigated.

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The samples were drawn from all students attending a Class "A" school during 1971-1972. Twenty-five courses had a sufficient number of black students to be included in the study. Comparisons were made between mean selection test scores, mean final school grades and academic attrition rates of the two racial groups. Regression lines were plotted for white and black students to investigate the usefulness of lower cutting scores for minorities. Predictive validities of the current selection composites and all other combinations of Basic Test Battery (BTB) tests were determined.

Differential validity of the operational BTB selectors was reaffirmed and alternative selectors were identified. The mean test scores of blacks were significantly lower than those of whites in all 25 courses but their final school grades were not significantly lower in 6 courses. Analysis of the regression lines demonstrated that lower aptitude blacks generally would earn higher grades than lower aptitude whites.

It was concluded that an improvement in minority assignment to technical training can be accomplished by implementing new selection composites, valid for both whites and blacks. Lowering the cutting score for blacks on the current combinations of BTB tests was counterindicated due to the chance-level validities of the operational composites in these courses.

FOREWORD

This research was performed under the Exploratory Development Task Area PF55.521.032 (Contemporary Social Issues) and Work Unit Number PF55.521.032.01.01 (Equal Opportunity Research). The research was initiated in response to joint Chief of Naval Operations (OP-01) and Bureau of Naval Personnel management objectives relating to the investigation of possible racial bias in selection, discipline, and advancement. The results of the research on discipline have been published in NPRDC TR 74-22, Perceptions of Discrimination in Non-Judicial Punishment, by Patricia J. Thomas, Edmund D. Thomas and Samuel W. Ward, June 1974.

The technical review of the data analysis portion of the report by Dr. Edward F. Alf is gratefully acknowledged.

J. J. CLARKIN
Commanding Officer

SUMMARY

Background and Purpose

During the past decade the Navy has been trying to find new ways to measure the talents of the educationally disadvantaged and train them in an appropriate rating. A recent effort looked at socioeconomic status and vocational interest as variables which might increase the predictive validity of the current aptitude measures. However, the results did not support the hypotheses and Basic Test Battery (BTB) scores continue to be the Navy's prime classification tool.

This research was initiated to determine whether earlier findings of differential BTB validities for black and white students in Class "A" schools would be replicated. If so, alternative combinations of tests could be investigated in an effort to increase the number of potentially successful black personnel being assigned to technical training.

Approach

The samples were drawn from all students attending Class "A" schools during 1971-1972. Twenty-five courses had records available for a minimum number of 20 black students and were included in the study. Final school grades were used as the criterion for judging the effectiveness of the current and alternative BTB selection composites.

Comparisons were made between the mean selection test scores, mean final school grades, and academic attrition rates of the two racial groups. Predictive validities and regression lines were determined for blacks and whites separately within each course. In those cases in which the current selectors were found to be invalid for blacks, other combinations of tests were evaluated.

Findings

Differential validity of the Navy's current aptitude tests was confirmed. The selection composites were valid ($p < .05$) for whites in all courses and for blacks in 14 of the 25 courses (page 7). In addition, significant differences between validities for each race were found in half of the schools studied (page 7). Alternative selection composites, valid for both blacks and whites, were identified (page 10).

The mean selection scores of blacks were significantly lower than those of whites in all 25 courses and their final school grades were lower in 19 courses (page 4). The attrition rate of blacks was significantly greater than that of whites in eight courses (page 7).

Analysis of the regression lines demonstrated that, for most courses, lower aptitude blacks have higher predicted grades than do lower aptitude whites, whereas a reversal is found at the upper end of the range (page 12). However, in those four courses in which the performance of the majority of black students was underpredicted, the use of a lower cutting score would not improve training opportunities since the selection composites were not valid for black samples (page 12). Significant differences between regression lines were found in 13 courses (page 12).

Conclusions and Recommendations

It was concluded that, in general, the relationship between the BTB selection composites and technical school grades is different for blacks than for whites (page 15). Other combinations of BTB tests were recommended for use in the selection of students for 7 of the 10 courses in which the current composites demonstrated chance level validity for blacks (page 16). Since no valid BTB alternatives were identified for the remaining three courses, additional research is required (page 17).

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RACIAL DIFFERENCES IN THE PREDICTION OF CLASS "A" SCHOOL GRADES

BACKGROUND AND PURPOSE

Since 1967, the Navy has expended considerable research effort attempting to increase the number of educationally disadvantaged personnel selected for technical training. Much of this effort has focused on the development of new test instruments that might be used in conjunction with, or in place of, the Navy Basic Test Battery (BTB). Generally, these instruments have been nonverbal, seemingly culture fair, and nonacademically anchored in an attempt to avoid the moderating role education is suspected of playing in traditional aptitude testing. Over the last 4 years, nearly 20 new tests have been experimentally administered to thousands of recruits. However, few of these tests have demonstrated validity for predicting performance on the job (Cory, 1975, in press).

Evidence continues to emerge which suggests that the operational Navy tests are not as valid for certain subgroups as they are for the majority of enlisted personnel. Thomas (1972) found that, while the BTB selection composites were valid predictors (at the .01 level) of school performance for white students in all 18 ratings studied, they failed to yield significant validities for black students in 9 of these ratings. Bilinski, Standlee and Saylor (1974) reported that when samples of blacks and whites who were underqualified on the BTB aptitude requirements were permitted to attend technical schools, minority students did as well as nonminority students in terms of course grades and better than nonminority students in terms of nonacademic behavior. While these findings were concerned with differences between the two racial groups, there is an underlying assumption that race is related to quality of educational opportunity and to cultural homogeneity.

Recent in-house research has attempted to deemphasize the race issue to focus on other measurable attributes that are believed to affect performance in technical training. The purpose of this effort was to decrease the reliance on traditional BTB composites as the primary criterion for recruit access to Navy technical training. Vocational interest and socioeconomic status were attributes singled out for investigation because of the availability of such data for large numbers of recruits and the apparently low relationships with racial membership.[1]

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[1] While socioeconomic status is related to race in the general population, the Navy attracts most of its enlistees from middle and lower level income groups. The highly disadvantaged have difficulty in meeting enlistment qualifications and the very advantaged tend to avoid the military services. As a result, the socioeconomic status of Navy recruits shows less variability and race relatedness than is found among their civilian counterparts.

In the vocational interest investigation (Dann, 1974), keys were developed for 10 different Navy ratings, and it was concluded that these interest measures did not increase the effectiveness of using aptitude measures to predict technical school grades. The socioeconomic status (SES) study (Durning, 1974) tested the hypothesis that low-aptitude, low-SES recruits would perform better in Navy schools than would low-aptitude, high-SES recruits.[2] It was presumed that the cultural and educational disadvantagement of the former group would result in their BTB scores being an underestimate of their "true" aptitude. Durning's findings failed to support this hypothesis.

The lack of success experienced by these approaches in finding variables that would identify potentially successful, lower aptitude school candidates raised the question of whether race was a moderator of performance. The findings reported by Thomas in 1972 indicate that black and white recruits represent two statistically different populations. Under these conditions, it might be feasible to use a differential cutoff score in recruit classification. This could be accomplished with minimal racial overtones by basing school selection on predicted final school grade, as suggested by Carroll and Lockman (1973). Thus, empirically based regression tables, developed for each race separately, would be used to determine eligibility for training.

The purposes of this study, evolving from previous research, were to determine if: (1) the operational selection composites continue to yield low predictive validities for black students; (2) composites which are significantly valid for black samples and do not appreciably lower the current validity for white samples can be identified; and (3) the regression lines obtained for black and white students indicate that lower cutting scores should be used in the assignment of minority personnel.

PROCEDURE

The Navy's Class "A" schools provide recruit graduates with fundamental training in ratings. Courses offered vary considerably in length, level of difficulty, and entrance requirements. Because this Center has been tasked to monitor the validity of using the BTB for predicting Class "A" school success, all schools routinely forward student performance data to the Navy Personnel Research and Development Center.

Sample

The reports received for Class "A" students graduating or disenrolling in calendar years 1971 and 1972 formed the pool from which

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[2]The term "low-aptitude" in this study is relative to the school population rather than to the total recruit population.

the samples were drawn. Those students whose racial code indicated that they were neither Negro nor Caucasian were eliminated from the sample, as well as those who were disenrolled for health, disciplinary, or administrative reasons. Thus, the intermediate sample consisted of 70,704 white and 2,884 black students who either graduated or disenrolled for academic reasons from Class "A" schools.[3]

The records for each technical training course offered at Class "A" schools were analyzed separately. Each course was examined to determine whether records were available for at least 20 black students. Courses not meeting this requirement were excluded from the analyses. The final samples consisted of records for 50,618 white students and 2,239 black students undergoing training for 25 different Navy ratings.

Variables

Predictors--The six BTB tests, which are administered to all recruits, are the General Classification Test (GCT), Arithmetic Test (ARI), Mechanical Test (MECH), Clerical Test (CLER), Shop Practices Test (SP), and Electronics Technician Selection Test (ETST). Specific minimum scores on a sum of two or three of these tests have been established as requirements for entry into Class "A" schools. These test composites are called selectors throughout this report.

Criterion--A final school grade is assigned to each student upon his graduation or disenrollment from a Class "A" school. These grades were standardized within each school represented in the sample to a mean of 50 and a standard deviation of 10. In this manner, data from several schools could be combined and meaningful comparisons made. The resultant Standardized Final School Grade (SFSG) was used as the criterion in this study.

Data Analysis

Means, standard deviations, and correlations among selectors and SFSGs were computed separately for blacks and whites within each of the 25 courses. Differences between the two groups were then tested for significance. Errors of estimate, slopes, and intercepts of the regression lines for minority and majority students were determined and the differences between them tested for significance. These tests were performed sequentially, in the manner suggested by Gulliksen and Wilks (1950), using small sample analyses.

Linear-sum validities of all possible combinations of BTB tests were computed for each course. In this manner the predictive validities

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[3]The 1969-1970 analysis reported in Thomas (1972) was based on 104,683 white students and 2067 black students. Thus, blacks constituted 1.9 percent of the total sample. The blacks in the present study constitituted 3.9 percent of the total sample.

of alternative selection composites were estimated and evaluated as potential substitutes for operational selectors demonstrating low validities. In addition, the correlations were corrected for the restriction in range of test scores which occurred when the samples were selected for technical training.

RESULTS AND DISCUSSION

Differences Between Selector Scores and School Grades

Table 1 presents data comparing the mean selector scores and mean SFSGs of white and black students in the 25 training courses. Whites had significantly higher selector means than blacks in all schools ($p < .01$), indicating that the tested aptitude level of black students was considerably below that of white students. Moreover, it appears that those responsible for assigning these men to technical training were practicing a form of reverse discrimination, since the black means were below the operational cutting scores in 13 of the courses (for whites, the mean was below the cutting score in PC school). Waivering the minimum selection score was probably a result of the effort to increase the representation of minorities in all ratings having a disproportionate racial balance.[4]

The school performance of the two racial groups was also compared. Whites earned significantly higher grades than blacks in 19 of the 25 courses. In the remaining six courses (AC, AD, DP, MM, PC, and TM) blacks, who scored significantly below whites on the selection composites, earned lower, but not significantly lower, grades in school.

Comparison of Attrition Rates

While it is important to know the mean criterion scores of the two racial groups, the percentage of students passing the courses is of greater interest to managers and policymakers. One of the questions frequently asked is, "Can we safely lower the cutting score without creating an excessive failure rate?" Since many of the black students scored below the established minimum selection scores, an evaluation of their failure rates seemed in order.

Table 2 presents academic attrition data for the students in the sample. A 10 percent attrition rate is generally considered tolerable in Class "A" schools. Black students exceeded this percentage in 11 of the 24 courses reporting attrition, while white students did so

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[4]It is obvious from selector score means and standard deviations presented in Table 1 that the selection score requirements were waivered for whites, too. Most probably this was due to the input of men from the fleet, who need not meet BTB selection requirements.

TABLE 1

Comparison of Selector Scores and Standardized Final School Grades (SFSG) of Black and White Students

Course		N Sample		Selector Score					SFSG				
				White		Black		Difference	White		Black		Difference
		White	Black	Mean	S.D	Mean	S.D.	Between Means[a]	Mean	S.D.	Mean	S.D.	Between Means[a]
AB	GCT+MECH+SP=156	835	29	165.70	12.87	152.86	12.97	12.84**	50.21	10.13	45.69	11.61	4.52*
AC	GCT+ARI=110	711	23	119.79	9.67	112.04	6.56	7.75**	50.09	9.45	48.87	5.69	1.22
AD	GCT+MECH+SP=156	1591	39	167.95	12.77	155.23	12.44	12.72**	49.98	9.85	47.97	8.53	2.01
AE	ARI+2ETST=160	1195	50	170.55	17.70	156.90	16.38	13.65**	49.81	9.81	47.04	9.26	2.77*
AM	GCT+MECH+SP=156	2252	48	168.24	12.58	155.69	14.75	12.55**	49.74	9.86	46.90	9.17	2.84*
AO	GCT+MECH+SP=156[b]	916	34	166.34	12.28	154.56	7.78	11.78**	50.00	9.79	45.65	10.89	4.35*
AZ	GCT+ARI=105	562	50	115.74	11.56	105.36	6.66	10.38**	50.41	9.89	45.28	8.76	5.13**
BT	GCT+MECH+SP=156	1806	58	164.97	12.50	153.72	8.08	11.61**	50.14	9.26	47.38	10.42	2.76*
CS/SD	GCT+ARI=100	1035	121	102.24	12.18	87.97	13.24	14.27**	50.55	8.72	45.17	9.42	5.38**
DP	GCT+ARI=110	593	34	120.72	10.88	112.09	9.62	8.63**	50.17	9.56	47.38	8.58	2.79
DT	GCT+ARI=100	769	116	112.06	11.74	101.25	7.90	10.81**	50.03	9.53	45.13	9.75	4.90**
EM	GCT+MECH+SP=156	1263	33	173.42	12.57	160.49	13.69	12.93**	50.82	9.78	44.36	9.19	6.46**
ET	ARI+2ETST=171	3606	115	194.96	12.40	184.35	11.92	10.61**	50.25	9.75	45.44	10.28	4.81**
HM	GCT+ARI=100	4418	438	113.97	12.49	102.44	9.25	11.53**	50.14	9.51	45.14	9.32	5.00**
MM	GCT+MECH+SP=156	5981	56	179.26	12.87	170.84	15.26	8.42**	50.62	9.59	48.77	9.37	1.85
OS	GCT+ARI=110	927	42	118.45	9.28	108.26	7.67	10.19**	49.91	9.27	43.26	9.52	6.65**
PC	GCT+ARI=110	125	23	102.99	12.31	93.61	11.92	9.38**	49.91	9.55	46.30	9.11	3.61
PE	ARI+2ETST=171	1329	40	187.59	13.22	179.18	10.87	8.41**	50.19	9.99	46.58	10.52	3.61*
PN	GCT+ARI=110	1735	104	119.09	10.87	108.54	11.61	10.55**	49.94	8.76	44.69	11.73	5.25**
QM	GCT+ARI=105	791	48	115.40	11.68	106.65	7.40	8.75**	49.89	9.79	44.06	8.08	5.83**
RM	GCT+ARI=100	2521	209	111.58	11.49	101.86	8.87	9.72**	50.40	9.17	45.72	11.01	4.68**
SK	GCT+ARI=105	1163	73	112.40	10.69	104.86	8.66	7.54**	49.65	8.61	46.23	10.52	3.42**
SM	GCT+CLER=110[c]	552	78	116.40	9.46	111.04	9.19	5.36**	50.36	9.07	44.90	9.81	5.46**
TM	GCT+ARI=110	1167	40	115.15	8.88	109.70	6.46	5.45**	50.08	9.71	47.95	10.10	2.13
YN	GCT+CLER=110	926	78	113.20	13.30	102.10	10.06	11.10**	50.38	8.77	44.22	10.24	6.16**

[a]The significance of the difference between means was determined through use of the *t* test.

[b]This selector was changed in June 1973 to ARI+ETST=105.

[c]This selector was changed in June 1973 to GCT+ARI=105

$*p < .05$

$**p < .01$

TABLE 2

Academic Attrition Rates for Blacks and Whites in Certain Class "A" Schools

Course	Attrition Rate Blacks	Attrition Rate Whites	χ^2
AB[a]	3.2	0.3	1.10
AC	0.0	10.3	1.57
AD[a]	0.0	0.2	0.96
AE[a]	13.5	12.9	0.01
AM[a]	0.0	0.0	
AO[a]	10.8	8.1	0.06
AZ	1.8	0.4	0.11
BT[a]	9.5	3.0	6.74**
CS/SD[a]	4.5	2.0	2.34
DP	8.3	10.2	0.00
DT	2.2	1.4	0.11
EM	0.0	1.0	0.08
ET	16.5	1.2	139.15**
HM	9.8	5.2	14.56**
MM	14.8	8.1	3.33
OS[a]	20.0	10.3	2.37
PC[a]	0.0	2.0	0.00
PE	40.4	32.3	0.49
PN[a]	21.0	7.9	16.78**
QM	23.5	10.2	5.44*
RM	10.4	3.9	18.53**
SK[a]	17.9	11.4	2.29
SM	5.6	1.7	4.13*
TM[a]	0.0	0.2	2.03
YN[a]	16.4	8.0	5.60*

[a]The mean selection score of black students was below the minimum cutting score established for school assignment.

*$p < .05$

**$p < .01$

in 7 courses. Two findings shown in the table are of particular importance. First, in 6 of the 12 schools in which the minority students had lower mean selector scores than the minimum cutting scores, the attrition rate was less than 10 percent. In three of the remaining six schools, the attrition rates of both majority and minority students exceeded 10 percent. Thus, it appears that the assignment of ineligible minority personnel to technical training was responsible for an excessive number of failures in 3 of the 12 schools. Second, despite the finding that blacks entered all schools with significantly lower selector scores than whites, significantly more black than white students failed in 8 of the 25 courses.

Differences in Validities

Federal standards set to ensure selection test fairness employ the validity coefficient, or the correlation between the test and a relevant criterion, as indicator of nondiscrimination. Title 41 of the Code of Federal Regulations (Department of Labor, 1971) states that "the relationship should be sufficiently high as to have a probability of no more than 1 to 20 to have occurred by chance. . . A test which is differentially valid may be used in groups for which it is valid but not for those in which it is not valid." While the military services have not yet been required to comply with this regulation, selection instruments that do not predict the relevant criterion above a chance level ($p < .05$) result in costly mismanagement of the manpower pool. Thus, for practical reasons, invalid selection methods should be replaced by valid ones.

In the earlier study of possible racial bias in the BTB (Thomas, 1972), it was reported that the selection composites were not significantly valid for blacks in about half of the schools studied. This finding was essentially replicated by the current research. Table 3 indicates that the operational selectors were not significantly valid for minority students in 11 of the 25 courses. As in the previous report, the selection composites were valid for whites in all courses at the .01 level of significance.[5] In addition, 11 out of 25 significant differences were found between the validities obtained with black and white samples, indicating that the selectors are differentially valid.

The validities of all possible two-test combinations of the BTB were investigated in the 11 courses having invalid selectors for blacks. In six of these courses, a significant relationship between a selector and the criterion could be achieved with minority samples if the selection composite were changed. These data are presented in Table 4. The validities reported by Thomas in 1972, when available, are included to indicate the stability over time of the findings.

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[5]Part of the explanation for lack of statistical significance with samples of black students lies in the small *Ns* available for analysis as compared to the substantially larger *Ns* of white students.

TABLE 3

Validities of Operational Selectors for
Black and White Students

Course	N Sample		Validity (Uncorrected)		
	White	Black	White	Black	Difference
AB	835	29	.33**	.15	.18
AC	711	23	.43**	-.01	.44*
AD	1591	39	.44**	.18	.26*
AE	1195	50	.55**	.24	.31**
AM	2252	48	.48**	.27	.21
AO	916	34	.44**	.05	.39*
AZ	562	50	.54**	.23	.31*
BT	1806	58	.41**	.08	.33**
CS/SD	1035	121	.52**	.47**	.05
DP	593	34	.52**	.40*	.12
DT	769	116	.52**	.35**	.17*
EM	1263	33	.42**	.63**	-.21
ET	3606	115	.54**	.46**	.12
HM	4418	438	.65**	.42**	.23**
MM	5981	56	.32**	.38**	-.06
OS	927	42	.57**	.48**	.09
PC	125	23	.26**	.10	.16
PE	1329	40	.62**	.59**	.03
PN	1735	104	.49**	.34**	.15*
QM	791	48	.56**	.03	.53**
RM	2521	209	.49**	.42**	.07
SK	1163	73	.44**	.40**	.04
SM	552	78	.27**	.28**	-.01
TM	1167	40	.24**	.21	.03
YN	926	78	.51**	.30**	.21*

*$p < .05$

**$p < .01$

TABLE 4

Alternative Selectors for Schools in Which Black Validities Were Not Significant

Rating	Current Selector	Black $\underline{r}$	White $\underline{r}$	Black $\underline{r}$ in 1972	Best Two-Test Composite[a]	Black $\underline{r}$	White $\underline{r}$	Black $\underline{r}$ in 1972	Next Best Two-Test Composite[a]	Black $\underline{r}$	White $\underline{r}$	Black $\underline{r}$ in 1972
AB	GCT+MECH+SP	.15	.33**	b	GCT+ARI	.31	.39**	b	ARI+ETST	.25	.38**	b
AC	GCT+ARI	-.01	.43**	b	CLER+SHOP	.17	.24**	b	CLER+ETST	.16	.35**	b
AD	GCT+MECH+SP	.18	.44**	.30*	ARI+SHOP	.40**	.44**	.27*	ARI+ETST	.37*	.46**	.34*
AE	ARI+2ETST	.24	.55**	.56**	GCT+CLER	.46**	.47**	.48**	GCT+ARI	.45**	.55**	.41**
AM	GCT+MECH+SP	.27	.48**	.34*	GCT+MECH	.29*	.47**	.45**	GCT+ETST	.29*	.46**	.35*
AO	GCT+MECH+SP[c]	.05	.44**	.13	CLER+ETST	.51**	.41**	.27	ARI+ETST	.43**	.50**	.32*
AZ	GCT+ARI	.23	.54**	.56*	ARI+SHOP	.29*	.44**	.08	CLER+SHOP	.26	.34**	.23
BT	GCT+MECH+SP	.08	.41**	b	MECH+ETST	.22	.38**	b	ARI+ETST	.19	.41**	b
AC	GCT+ARI	.10	.26**	.50*	(None better)				(None better)			
QM	GCT+ARI	.03	.56**	.30	ARI+SHOP	.20	.47**	.42*	ARI+MECH	.19	.47**	.31
TM	GCT+ARI	.21	.24**	b	ARI+MECH	.46**	.27**	b	ARI+SHOP	.37*	.26**	b

[a]Based on black samples.

[b]Not analyzed in 1972 report.

[c]This selector was changed to ARI+ETST=105 in June 1973.

*$\underline{p} < .05$

**$\underline{p} < .01$

Whenever the validity of a test used in selecting a sample is compared to that of another test not used, the variances of the two instruments should be considered. Guilford (1965) pointed out that, "The size of the $\underline{r}$ is very much dependent upon the variability of measured values in the correlated sample. The greater the variability, the higher will be the correlation, everything else being equal." In selection research, this means that the validities for the operational selectors generally will be derived from tests having less variability than alternative combinations of tests. Therefore, the finding that other BTB tests are more valid predictors of school performance than the selectors could be a function of the restricted range of selector scores displayed by the samples. In order to avoid unfair comparisons between the operational selectors and other BTB combinations, all validities were corrected for restriction of range. This technique yielded estimates of the validities within the population of interest, not just the research samples, and permitted more reliable evaluations of validities.

Table 5 presents the corrected validities for black students for both the operational selectors and the alternative composites presented in Table 4. These validities were corrected for direct restriction on the selection tests using estimates of population parameters--statistics obtained with 2,156 black recruits tested in 1972.[6]

The results shown in Tables 4 and 5 demonstrate that stable, valid selectors for black students can be substituted for the currently invalid selectors for AD, AE, AM, and AO courses. For these ratings combinations of BTB tests were identified which were valid in both the 1972 and the current studies, did not fall appreciably when corrected for restriction of range, and did not reduce the current predictive validity for white students. While selection of blacks for the TM course also would be greatly improved by changing the selection composite, there was no way of examining the stability over time of the recommended composite. No combination of BTB tests achieved significance for black students in AB, AC, BT, PC, and QM training. However, the best two-test composite that was identified for the QM course in this study achieved significance in the 1972 study. In addition, the validity of the best composite for the AB course for blacks also increases the validity for white students by .06 correlation points. Thus, it would appear that blacks would be treated more equitably if the selectors for AB and QM courses were changed to these alternative composites.

A cutting score analysis was performed within the seven courses where valid selection changes seemed indicated. By ranking the black

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[6]BTB scores of all recruits entering the training centers are periodically collected to provide population statistics used in correcting for restriction of range.

TABLE 5

Validities of Current Selectors and Alternative Composites
Corrected for Restriction of Range for Black Samples Only

Rating	Current Selector	r	r_c	Best Two-Test Composite[a]	r	r_c	Next Best Two Test Composite[a]	r	r_c
AB	GCT+MECH+SP	.15	.17	GCT+ARI	.31	.32	ARI+ETST	.25	.27
AC	GCT+ARI	-.01	-.02	CLER+SP	.17	.13	CLER+ETST	.16	.14
AD	GCT+MECH+SP	.18	.19	ARI+SP	.40**	.35	ARI+ETST	.37*	.37
AE	ARI+2ETST	.24	.26	GCT+CLER	.46**	.44	GCT+ARI	.45**	.40
AM	GCT+MECH+SP	.27	.30	GCT+MECH	.29*	.31	GCT+ETST	.29*	.30
AO	GCT+MECH+SP[b]	.04	.06	CLER+ETST	.51**	.51	ARI+ETST	.43*	.43
AZ	GCT+ARI	.23	.24	ARI+SP	.29*	.26	CLER+SP	.26[b]	.26
BT	GCT+MECH+SP	.08	.08	MECH+ETST	.22	.17	ARI+ETST	.19	.20
QM	GCT+ARI	.03	.02	ARI+SP	.20	.16	ARI+MECH	.19	.17
TM	GCT+ARI	.20	.24	ARI+MECH	.46**	.34	ARI+SP	.37*	.31

[a]Best for black samples

[b]This selector was changed in June 1973 to ARI+ETST=105.

$*p < .05$

$**p < .01$

students on their scores on the new composites, the final grades and attrition rates of those scoring at different levels could be evaluated. In this manner, recommended minimum qualifying scores were developed that would permit the school assignment of a substantial number of blacks but still keep attrition within reasonable limits. These cutting scores are presented in the Conclusions and Recommendations section. While any analyses based on the small black samples in this study admittedly have limitations, it is believed that these empirically derived cutting scores are better than arbitrary ones.

Differences Between Regression Lines

The graphs in Appendix A present the regression lines for black and white students in each of the 25 technical training courses using current selectors. The F ratios of the three null hypotheses testing the equality of each pair of lines are presented on the figures. Rejection of one hypothesis is sufficient to demonstrate statistically that the samples were drawn from two different populations. Table 6 presents the actual values for errors of estimate, slopes and intercepts for each race within each course from which the F ratios were computed.

Table 7 summarizes the results of the regression analyses. The standard errors of estimate of the majority and minority groups differed significantly in nine courses. For the most part, the standard errors of estimate obtained for black students were larger than those obtained for white students (see Table 6). The second hypothesis tested was equality of slopes. In three courses the slopes of the two races differed. Tests of equality of intercepts resulted in one additional significant difference. Thus, the analyses of equality of regression lines for the two races resulted in the rejection of the null hypothesis for 13 of the 25 courses.

The regression lines may be used to indicate how members of the two races would be expected to perform at different cutting score levels on the operational selectors and whether differential cutting scores should be applied. In 13 of the courses, the regression line for blacks was above that of whites on the left side of the graph but fell below that of whites at a point beyond the black 10th centile. This indicates that lower aptitude blacks, representing at least 10 percent of the black sample, have higher predicted grades in technical school than lower aptitude whites while the positions of the two races reverse at the upper range of test scores. Of particular interest to the research effort are those graphs which show at least one-half standard deviation separating the two regression lines at the 10th centile. Such a pattern of underprediction of lower scoring black personnel occurred in the AC, AD, AE, and AM courses. Table 3 (page 8) reveals that the composites used in selection to these four courses were not significant ($p < .05$) predictors of the performance of black students. Thus, a change in the combination of selection tests would be more likely to improve the assignment of potentially successful black students to these courses than would lowering the cutting score.

TABLE 6

Tests of Equality of Regression Lines

Course	Error of Estimate White	Error of Estimate Black	F Ratio[a]	Slope White	Slope Black	F Ratio[b]	Intercept White	Intercept Black	F Ratio[b]
AB	9.5711	11.6902	1.4918	.2587	.1353	.7451	7.3456	24.9978	.4593
AC	8.5396	5.8246	2.1495**	.4206	-.0125	2.4399	- .2977	50.2739	1.2015
AD	8.7944	8.3791	1.1015	.3474	.1696	2.3522	-8.3647	21.6343	2.6798
AE	8.1825	9.1744	1.2571	.3063	.1102	7.2245**	-2.4449	29.7415	1.2043
AM	8.6580	8.8670	1.0488	.3753	.1822	4.9444*	-13.4057	18.5270	1.9823
AO	8.8142	11.0486	1.5712*	.3485	.0609	2.0557	-7.9812	36.2247	.0352
AZ	8.3280	8.6114	1.0692	.4625	.3005	.7952	-3.1224	13.6088	.0879
BT	8.4649	10.4143	1.5136*	.2999	.1751	.7859	.6478	20.4572	.2701
CS/SD	7.4405	8.3366	1.2553	.3742	.3359	.4768	12.2945	15.6153	.0215
DP	8.1640	7.9957	1.0425	.4576	.3535	.4770	-5.0850	7.7486	.5980
DT	8.1526	9.1323	1.2547	.4218	.4444	.0500	2.7608	0.1286	.1433
EM	8.9004	7.2432	1.5099	.3239	.4234	.7331	-5.3702	-23.5956	1.9700
ET	8.2276	9.1491	1.2366*	.4220	.3995	.1168	-32.0357	-28.2072	.1755
HM	7.2628	8.4519	1.3542**	.4920	.4263	2.8179	-5.9403	1.4678	2.7456
MM	9.1112	8.7580	1.0822	.2320	.2314	- .0015	9.0191	9.2260	.0075
OS	7.6067	8.4432	1.2320	.5715	.5986	.0294	-17.7937	-21.5531	.4323
PC	9.2546	9.2807	1.0056	.2044	.0760	.5161	28.8520	39.1885	.7304
PE	7.8377	8.5734	1.1965	.4683	.5744	.8229	-37.6735	-56.3539	.0733
PN	7.6569	11.0594	2.0862**	.3924	.3500	.3752	3.2032	6.7016	1.9203
QM	8.1255	8.1593	1.0083	.4685	.0303	7.3121**	-4.1871	40.8286	2.1630
RM	8.0103	10.0102	1.5616**	.3884	.5238	4.2725*	7.0565	-7.6380	1.9403
SK	7.7447	9.7266	1.5772**	.3528	.4796	1.3482	9.9952	-4.0655	.5660
SM	8.7443	9.4787	1.1750	.2583	.2982	.1173	20.2845	11.7765	13.8917**
TM	9.4386	10.0146	1.1257	.2596	.3197	.0648	20.1807	12.8680	.2117
YN	7.5674	9.8188	1.6835**	.3340	.3086	.0794	12.5679	12.7023	6.9309**

[a] df = N_1-2 and N_2-2

[b] df = 1 and N-2

*p < .05

**p < .01

TABLE 7

Results of Sequential Tests of Equality of Regression Lines for Black and White Students

Course	Different Errors of Estimate?	Different Slopes?	Different Intercepts?	Equality Supported?
AB				yes
AC	yes	--	--	no
AD				yes
AE		yes	--	no
AM		yes	--	no
AO	yes	--	--	no
AZ				yes
BT	yes	--	--	no
CS/SD				yes
DP				yes
DT				yes
EM				yes
ET	yes	--	--	no
HM	yes	--	--	no
MM				yes
OS				yes
PC				yes
PE				yes
PN	yes	--	--	no
QM		yes	--	no
RM	yes	--	--	no
SK	yes	--	--	no
SM			yes	no
TM				yes
YN	yes	--	--	no

Note.--If the difference between the two races was significant at the .05 level, the null hypothesis was rejected.

CONCLUSIONS AND RECOMMENDATIONS

The relationship between BTB selection composites and technical school grades was shown to be different for black and white personnel. This conclusion is based on the following five findings:

1. The selection test scores of blacks were significantly lower than those of whites in all courses. Yet, the final school grades of blacks were not significantly lower in 6 of the 25 courses (Table 1).

2. The attrition rate of blacks was significantly higher than that of whites in 8 of the 25 courses (Table 2).

3. The operational selection composites were valid predictors of the school performance of whites in all 25 courses studied, but were predictive for blacks in 14 courses (Table 3).

4. The selection composites were differentially valid in 11 of the 25 courses (Table 3).

5. The regression lines of whites and blacks differed significantly in 13 of the 25 courses (Table 7).

The third and fourth findings are consistent with a previous study (Thomas, 1972) on possible bias in selection in the Navy.[7] Thus, differential validity of Navy classification composites has been confirmed.

Changes in the combinations of BTB tests used in selecting students are clearly indicated for the AD, AE, AM and AO courses. Tentative evidence also was presented for changing the current selectors for the AB, QM, and TM courses. None of the combinations of BTB tests yielded significant validities for the remaining three courses, i.e., AC, BT, and PC. Since the current selectors yielded validities of .01, .08, and .10 for black students in these three courses, lack of significance does not appear to be simply a function of small samples. It also does not appear to be a reflection of small variances, since correcting these validities for restriction of range did not result in larger correlations. However, all of the black validities may have been affected by other factors that entered into the selection decisions and resulted in many members being admitted to training courses.

Based on these conclusions, the following changes are strongly recommended:

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[7] Data concerning mean predictor and criterion scores, attrition rates, and regression lines for each course were not presented in that report.

1. The selection composite for the AD course should be changed from GCT+MECH+SP=156 to ARI+ETST=90.[8] While ARI+SP was the most valid combination in this study, its correlation fell to .35 when corrected for restriction and it did not achieve as high a validity as ARI+ETST yielded in the 1972 study.

2. The selection composite for the AE course should be changed from ARI+2ETST=160 to GCT+ARI=95. This recommended composite was as valid as the current selector for the white sample, dropped only slightly upon correction for restriction, and was valid at the .05 level in 1972.

3. The selection composite for the AM course should be changed from GCT+MECH+SP=156 to GCT+MECH=90, the most valid two-test composite in both studies.

4. The selection composite for the AO course was changed in June 1973 from GCT+MECH+SP=156 to ARI+ETST=105. This recommended combination of tests was the most valid predictor of black performance in 1972 and was more predictive of the performance of white students than the operational selector in this study. It is recommended, however, that the cutting score be lowered to 95.

5. The selection composite for the TM course should be changed from GCT+ARI=110 to ARI+MECH=90. While there were no data on this course in the 1972 report, the recommended composite would in no way detract from the selection validity for white students and would increase the validity for black students from .20 to .46 (significant at the .01 level).

Two other changes, while not strongly supported by the data, are likely to improve the selection of black students above a chance level. Thus, the following changes should be considered:

1. The selection composite for the AB course could be changed from GCT+MECH+SP=156 to GCT+ARI=90. This composite was more valid for black students and .06 correlation points higher for whites than the operational selector.

2. The selection composite for the QM course could be changed from GCT+ARI=105 to ARI+SP=95. This alternative composite was valid for black students in the 1972 study and .17 correlation points higher for blacks in this study.

Cutting scores on all recommended new selectors have been set low enough to qualify substantial numbers of minorities for technical training. This study demonstrated that most blacks passed the technical

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[8] The recommended cutting score was set so that use of the new selector and cutoff would: (1) lower the attrition rate to below 10% (if any attrition was reported), and (2) result in those scoring in the lowest 5-point interval on the selector earning a mean final school grade less than one-half standard deviation below the group mean final school grade.

course to which they were assigned despite the finding that their mean selection scores were below the minimum cutting scores. Whatever informal action led to their assignment to these courses needs to be systematized to ensure that all motivated lower aptitude personnel have the same opportunity for training.

The search for valid predictors of performance in AB, AC, BT, PC, and QM training must continue. The use of invalid selection procedures is not only wasteful of available talents but unsupportable in a moral and legal sense.

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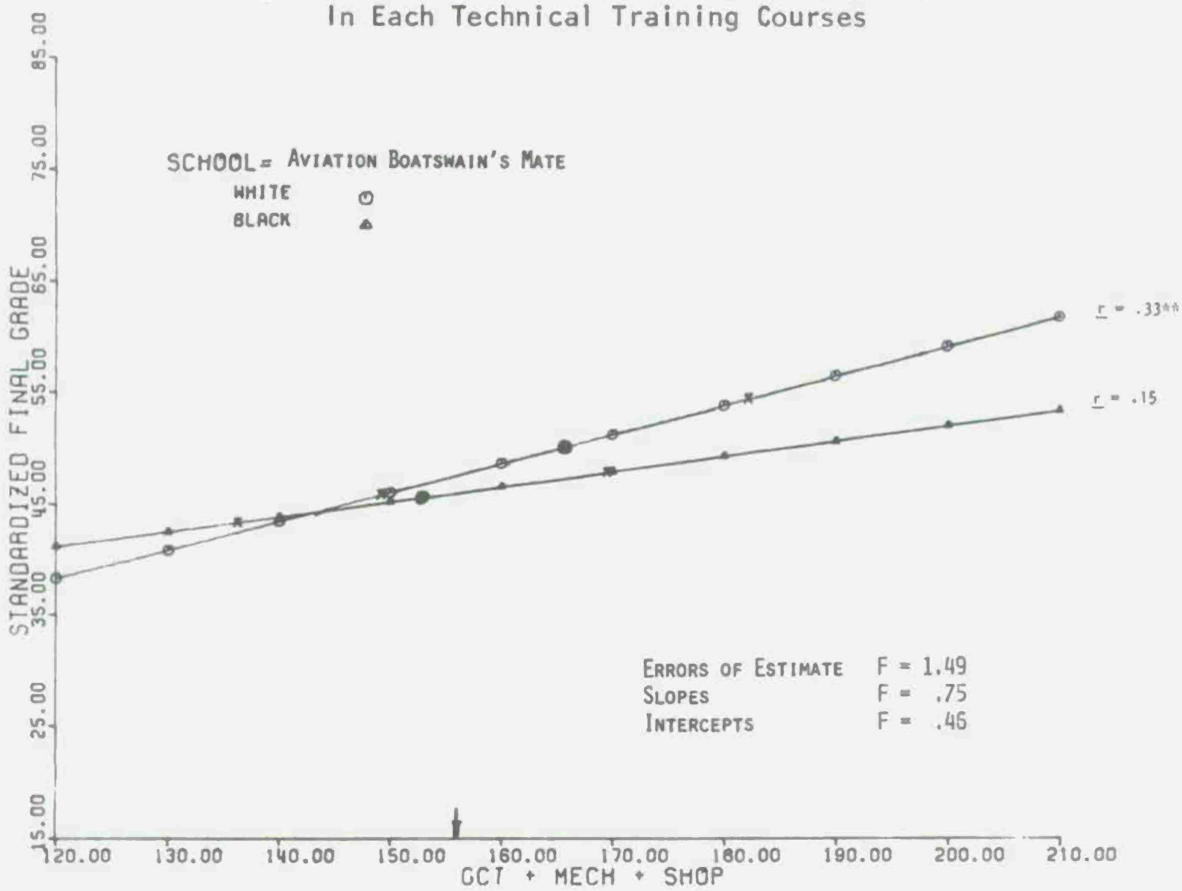
REFERENCE NOTE

Cory, C. H. Personal communication, 20 Sep 1974.

APPENDIX A

Regression Lines for Black and White Students
In Each Technical Training Courses

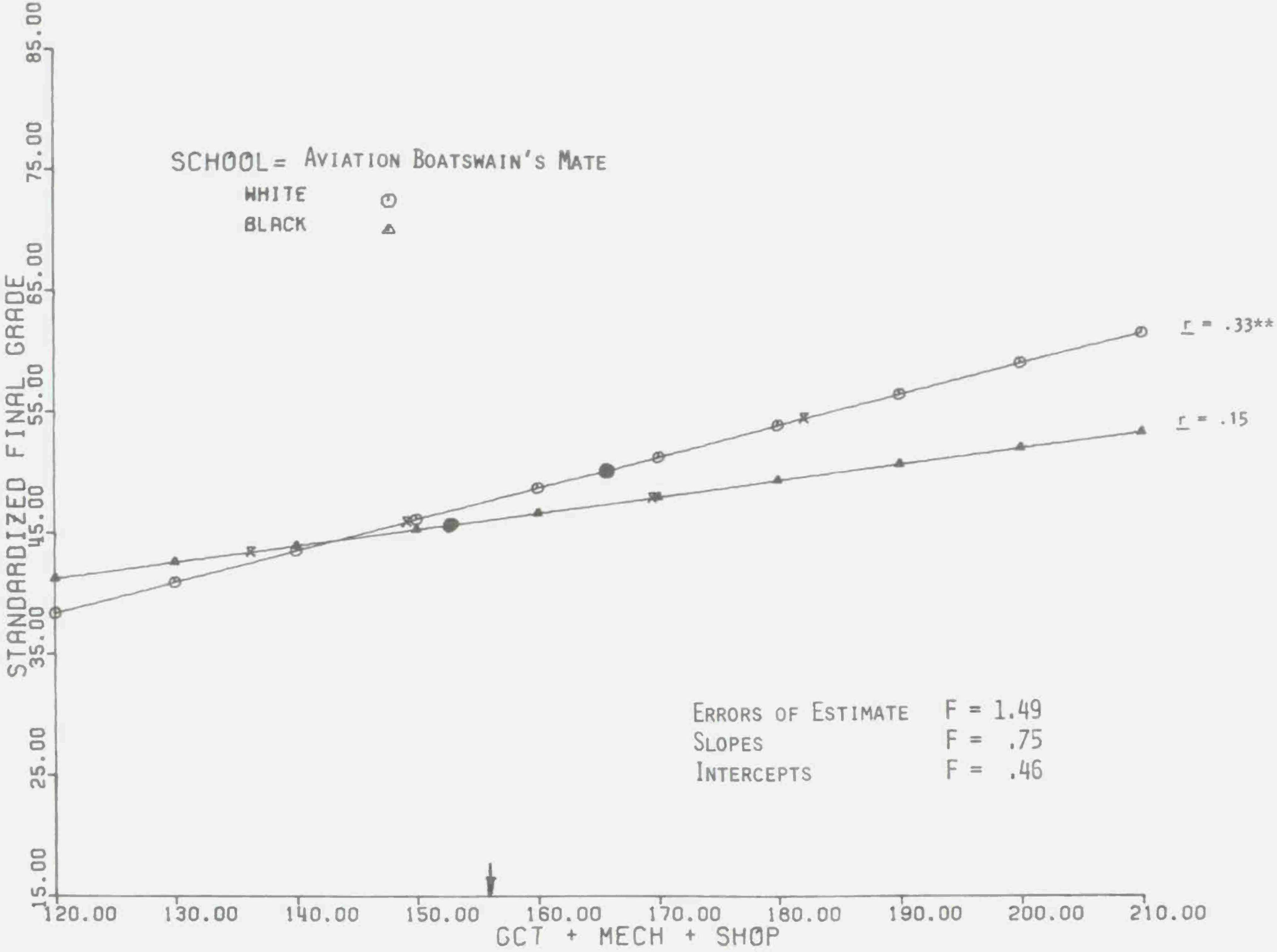


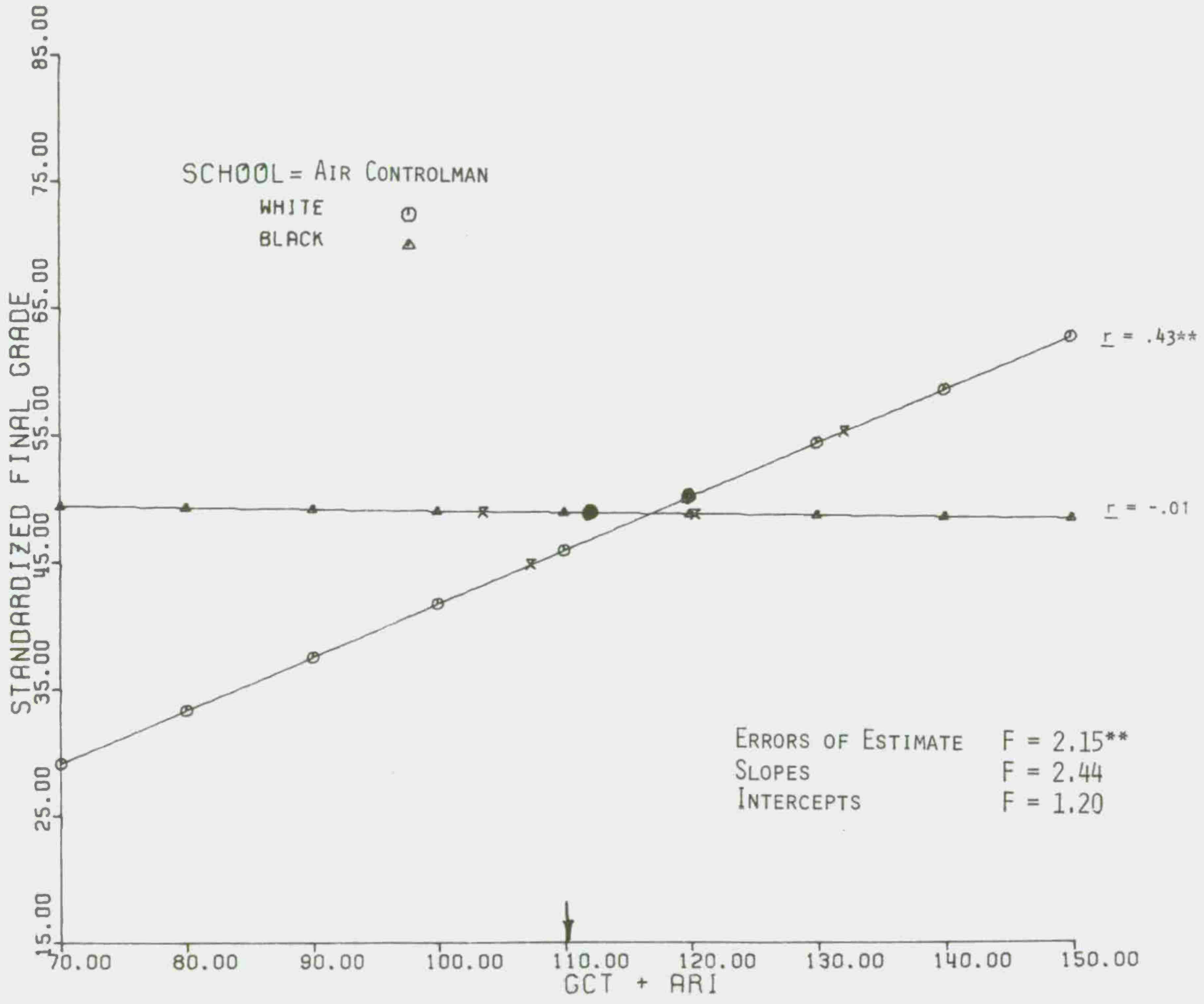
• 50th Centile Point

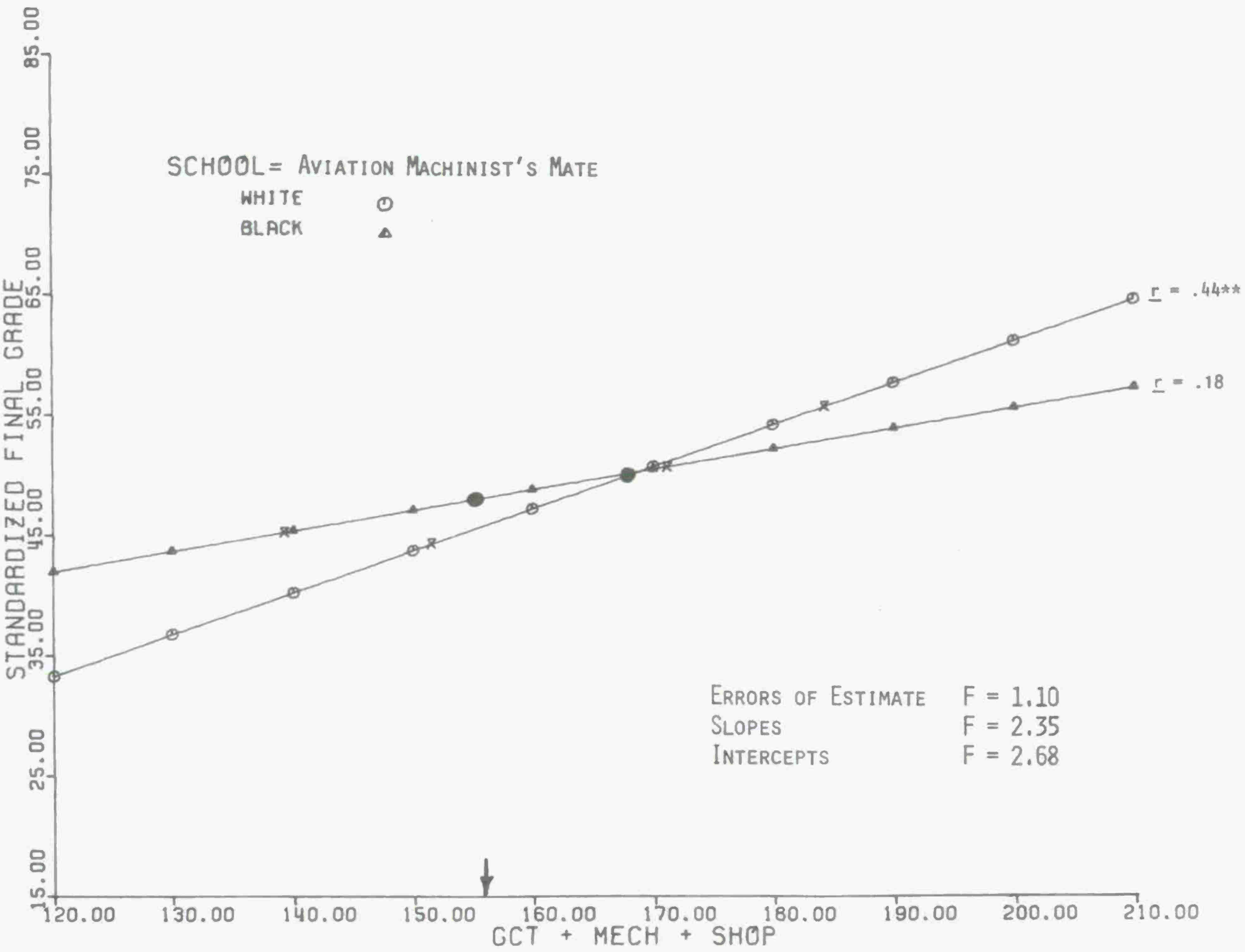
X----X 10th and 90th Centile Points

↓ Minimum Qualifying Score for Assignment to Course

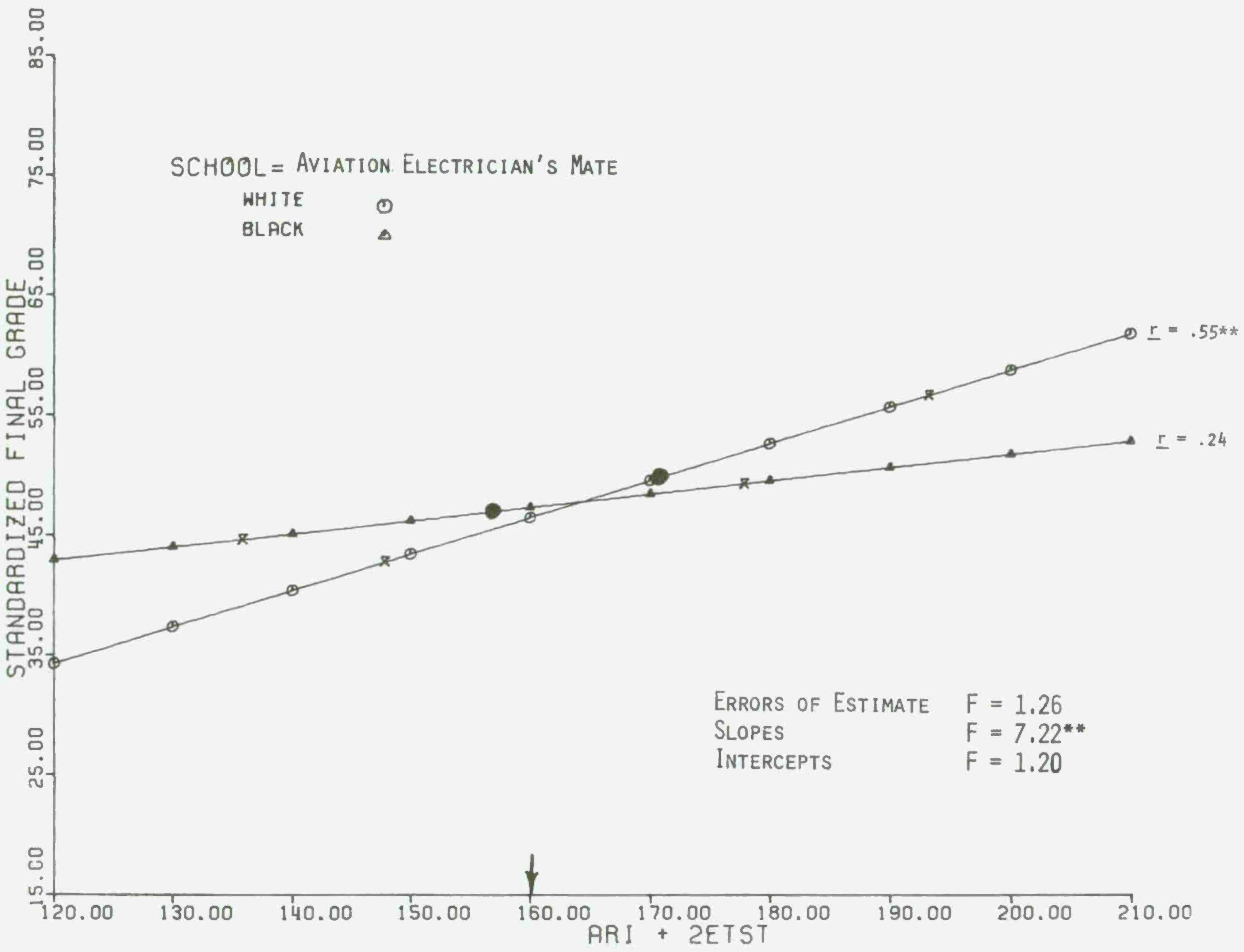
r Correlation Between Selection Composite and Standardized Final School Grade (Validity)


SCHOOL= AVIATION BOATSWAIN'S MATE
WHITE
BLACK
r = .33**
r = .15
ERRORS OF ESTIMATE F = 1.49
SLOPES F = .75
INTERCEPTS F = .46
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
GCT + MECH + SHOP


SCHOOL = AIR CONTROLMAN
WHITE
BLACK
r = .43**
r = -.01
ERRORS OF ESTIMATE F = 2.15**
SLOPES F = 2.44
INTERCEPTS F = 1.20
STANDARDIZED FINAL GRADE
GCT + ARI
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00



SCHOOL= AVIATION MACHINIST'S MATE
WHITE
BLACK
r = .44**
r = .18
ERRORS OF ESTIMATE F = 1.10
SLOPES F = 2.35
INTERCEPTS F = 2.68
STANDARDIZED FINAL GRADE
85.00
75.00
65.00
55.00
45.00
35.00
25.00
15.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
GCT + MECH + SHOP


SCHOOL= AVIATION ELECTRICIAN'S MATE
WHITE
BLACK
r = .55**
r = .24
ERRORS OF ESTIMATE F = 1.26
SLOPES F = 7.22**
INTERCEPTS F = 1.20
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
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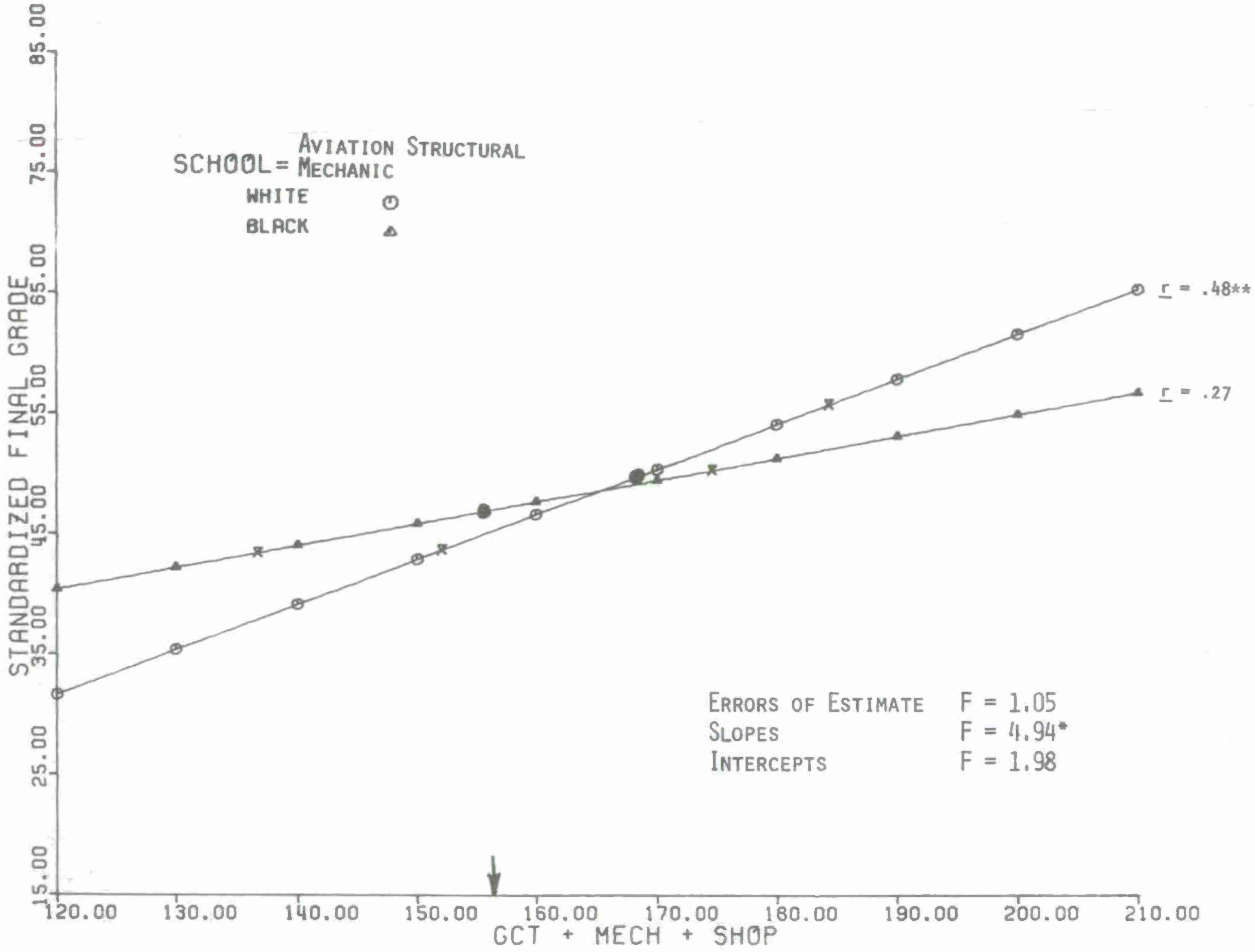
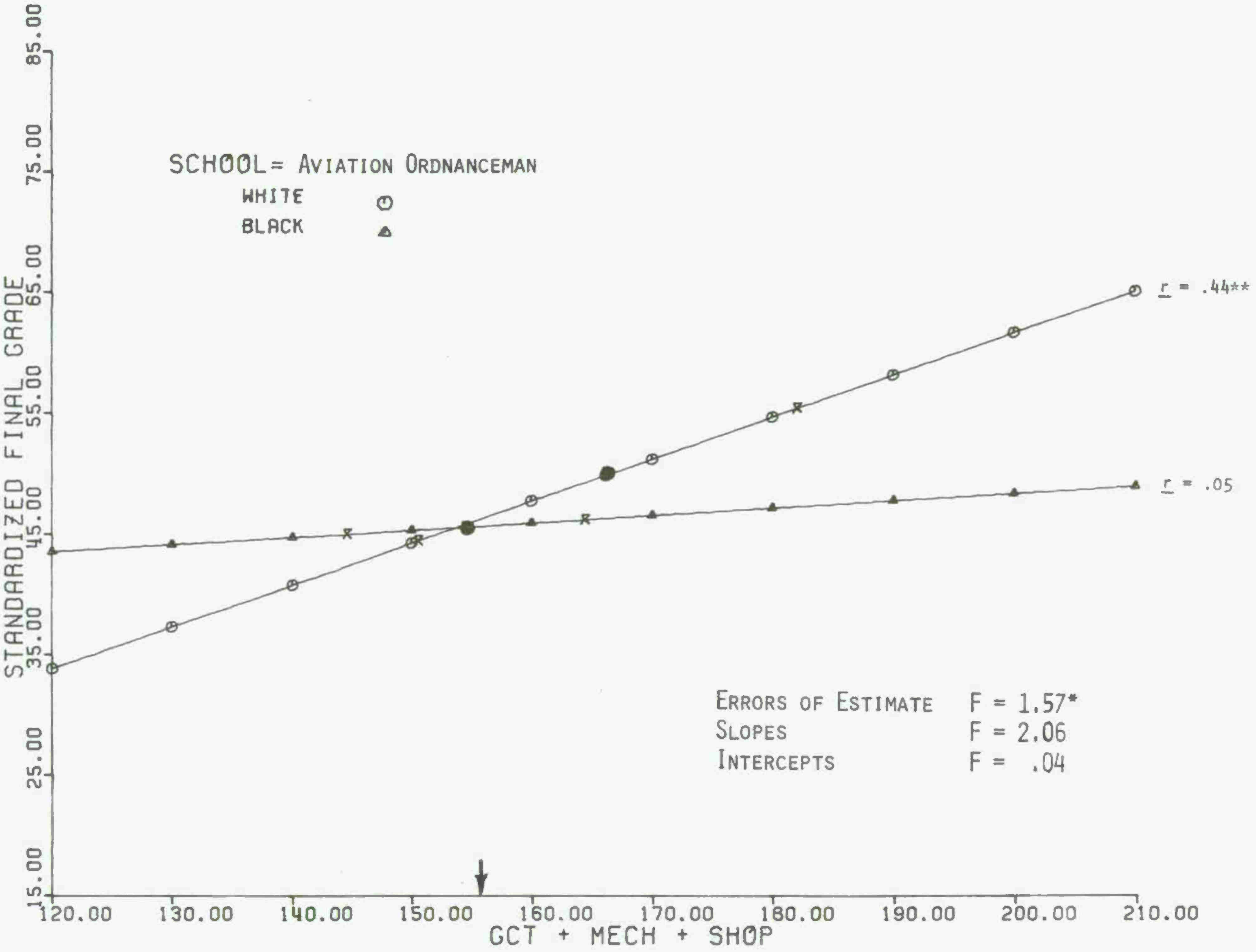
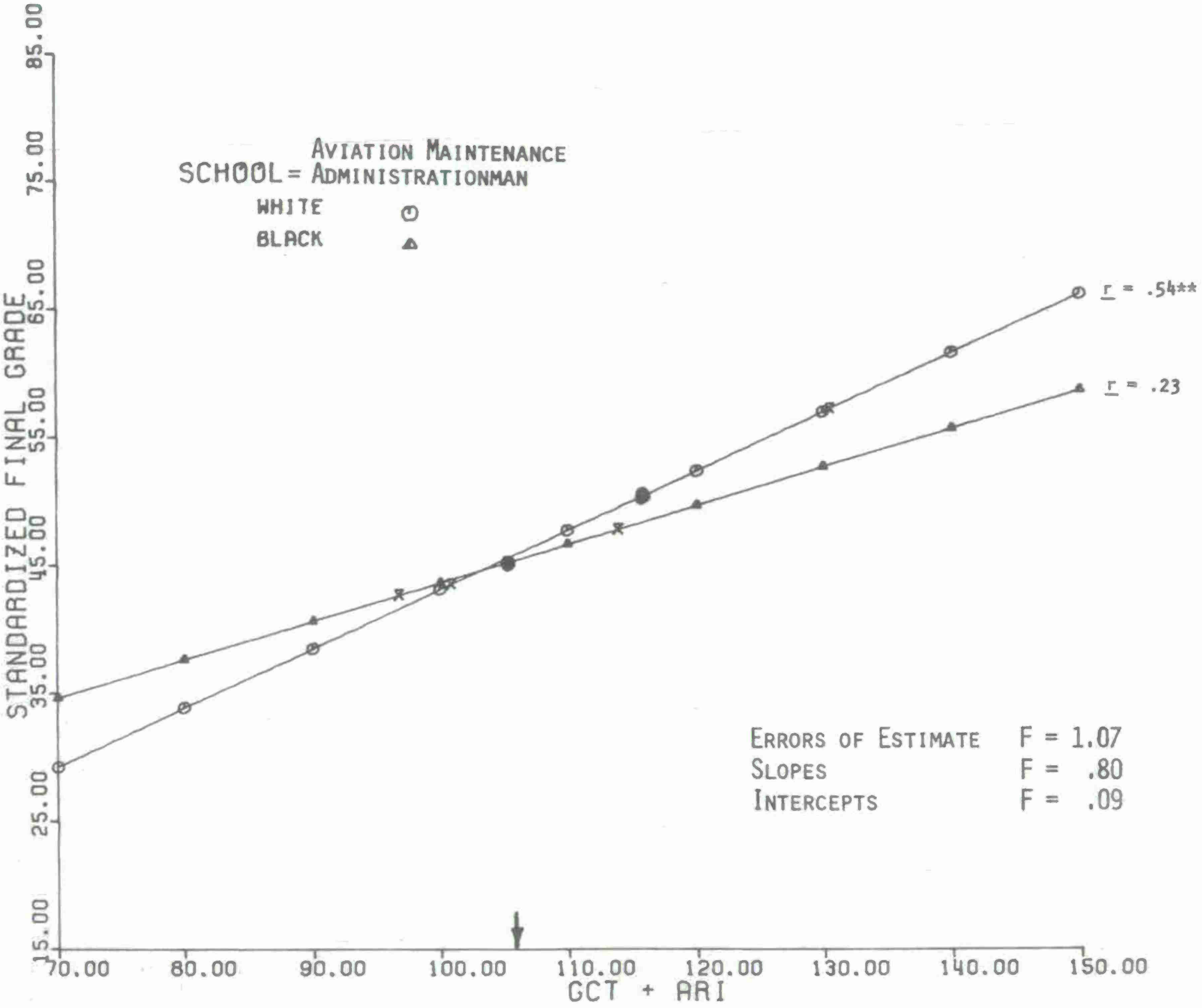
160.00
170.00
180.00
190.00
200.00
210.00
ARI + 2ETST


SCHOOL = Aviation Structural Mechanic
WHITE
BLACK
r = .48**
r = .27
Errors of Estimate F = 1.05
Slopes F = 4.94*
Intercepts F = 1.98
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
GCT + MECH + SHOP


SCHOOL= AVIATION ORDNANCEMAN
WHITE
BLACK
r = .44**
r = .05
ERRORS OF ESTIMATE F = 1.57*
SLOPES F = 2.06
INTERCEPTS F = .04
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
GCT + MECH + SHOP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SCHOOL = ADMINISTRATIONMAN
WHITE
BLACK
r = .54**
r = .23
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INTERCEPTS F = .09
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
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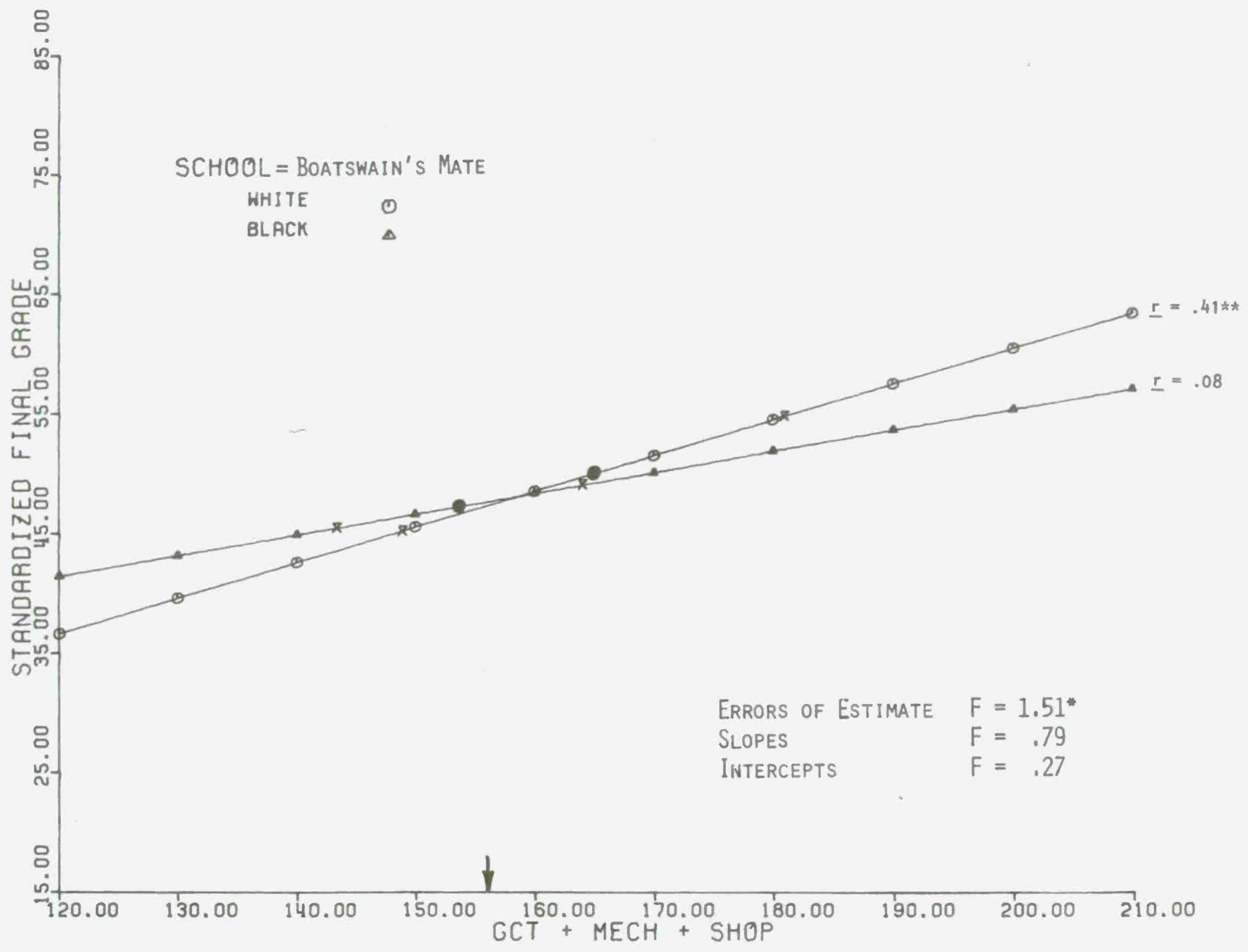
140.00
150.00
GCT + ARI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BLACK
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
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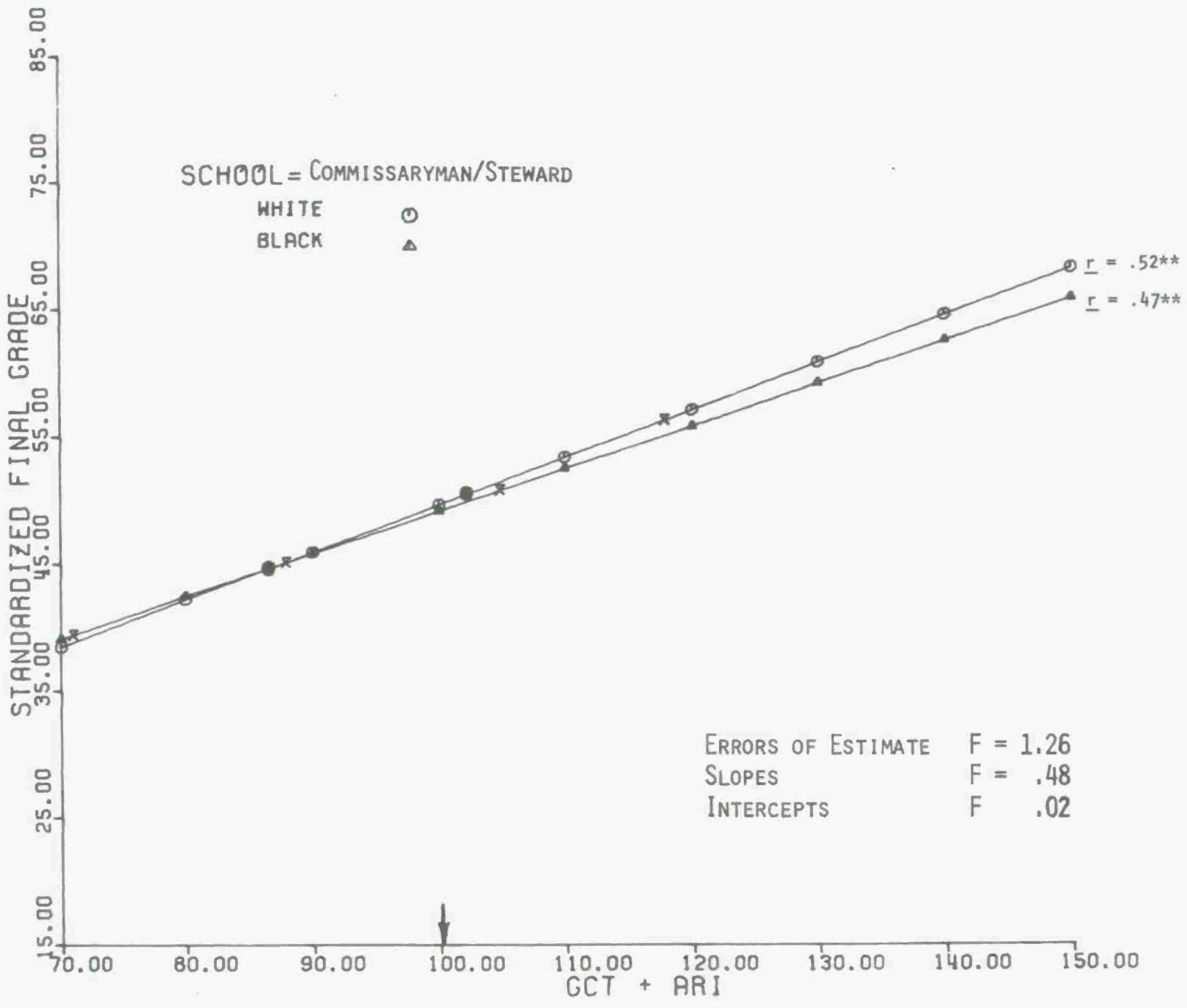
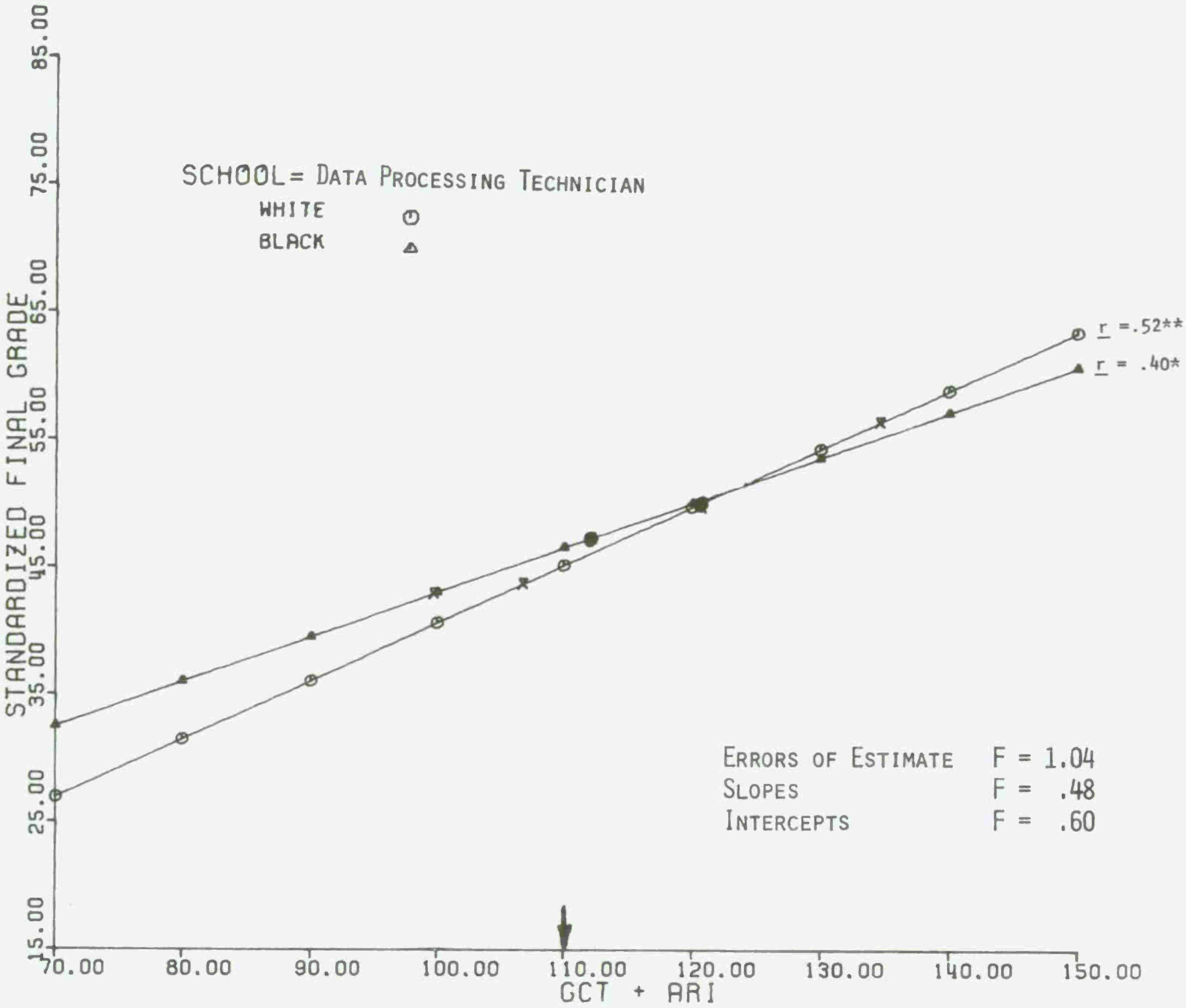
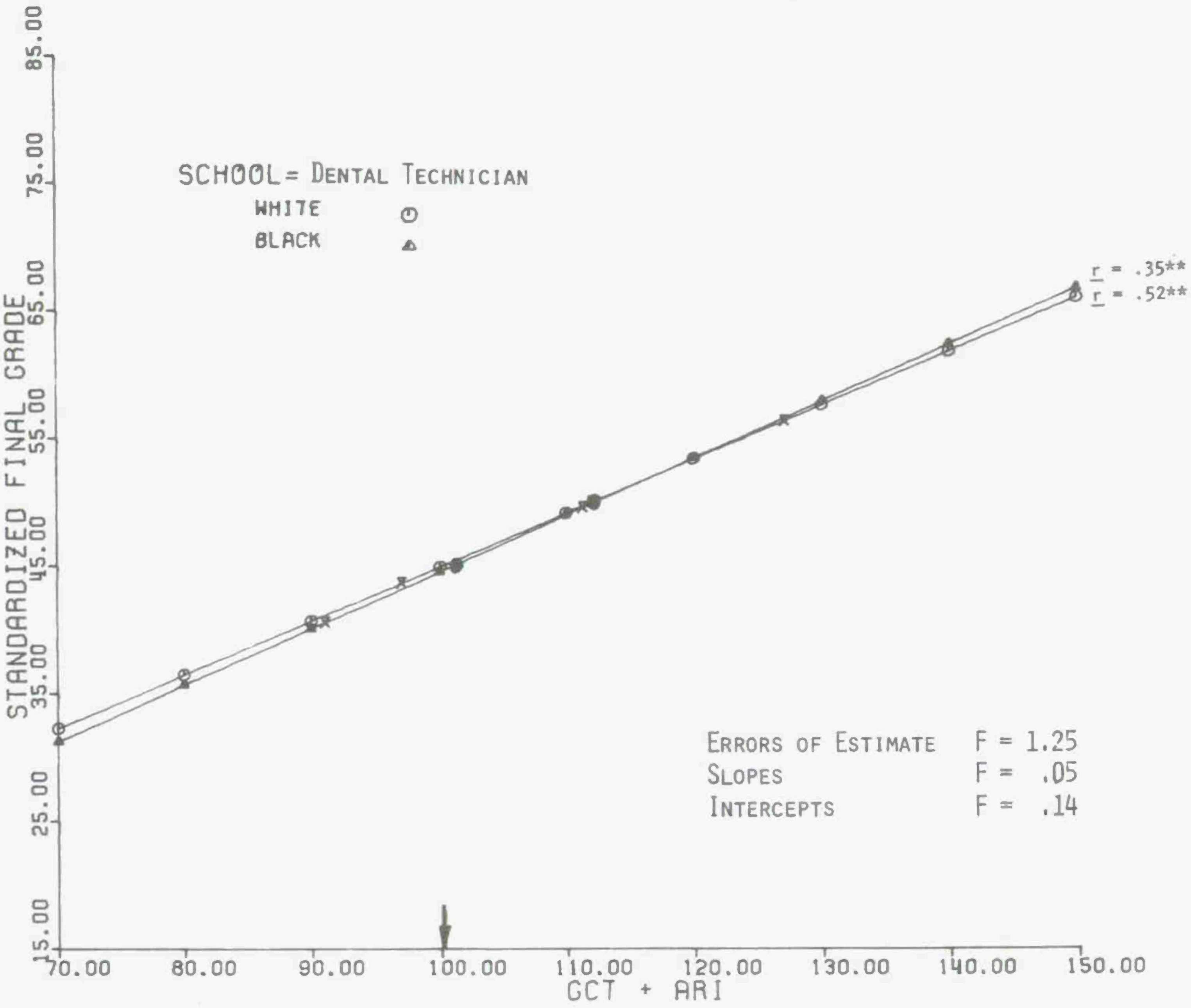
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
GCT + MECH + SHOP
r = .41**
r = .08
ERRORS OF ESTIMATE F = 1.51*
SLOPES F = .79
INTERCEPTS F = .27



SCHOOL = COMMISSARYMAN/STEWARD
WHITE
BLACK
r = .52**
r = .47**
STANDARDIZED FINAL GRADE
85.00
75.00
65.00
55.00
45.00
35.00
25.00
15.00
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00
GCT + ARI
ERRORS OF ESTIMATE F = 1.26
SLOPES F = .48
INTERCEPTS F .02



SCHOOL= DATA PROCESSING TECHNICIAN
WHITE
BLACK
STANDARDIZED FINAL GRADE
85.00
75.00
65.00
55.00
45.00
35.00
25.00
15.00
r =.52**
r = .40*
ERRORS OF ESTIMATE F = 1.04
SLOPES F = .48
INTERCEPTS F = .60
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00
GCT + ARI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BLACK
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r = .52**
ERRORS OF ESTIMATE F = 1.25
SLOPES F = .05
INTERCEPTS F = .14
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
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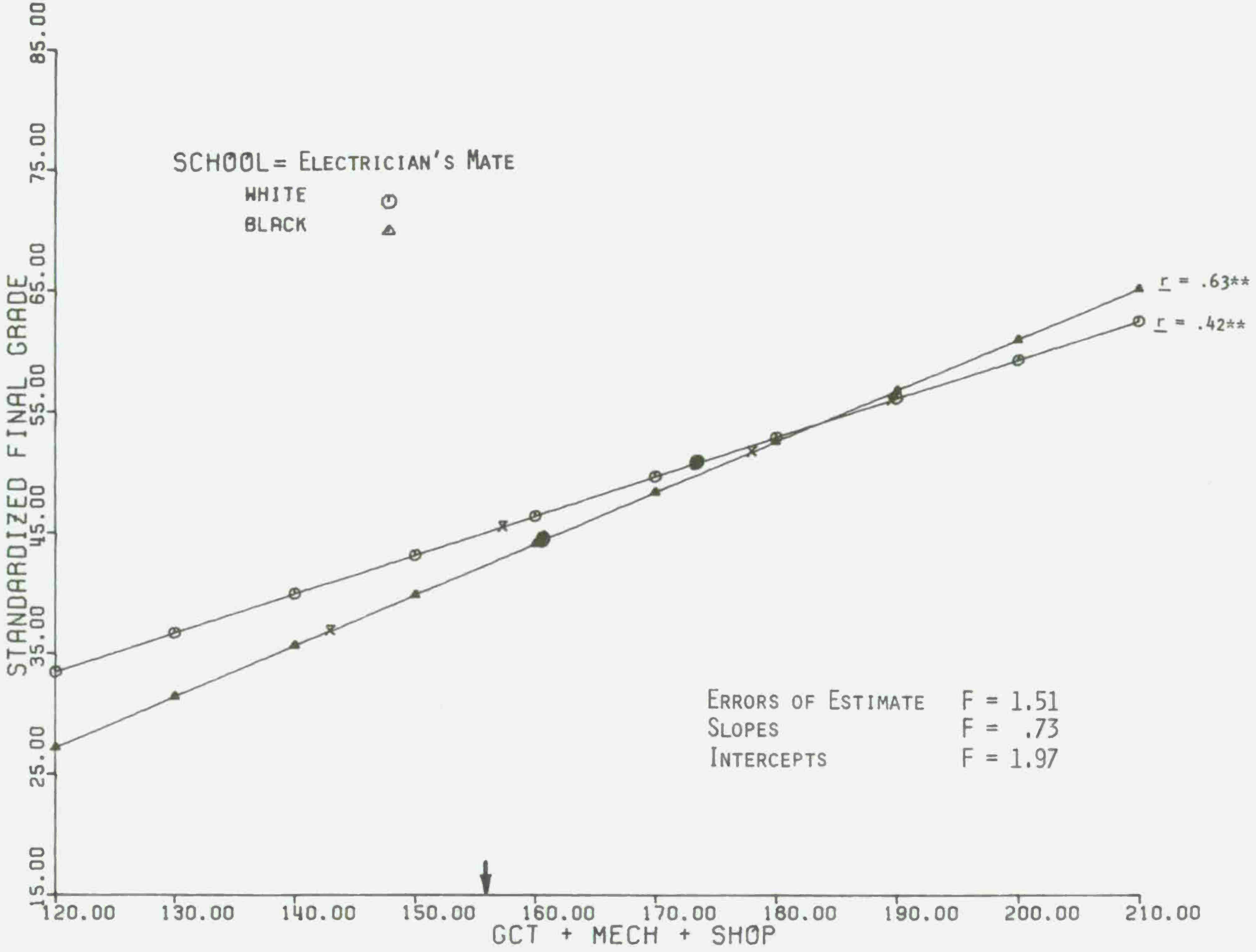
130.00
140.00
150.00
GCT + ARI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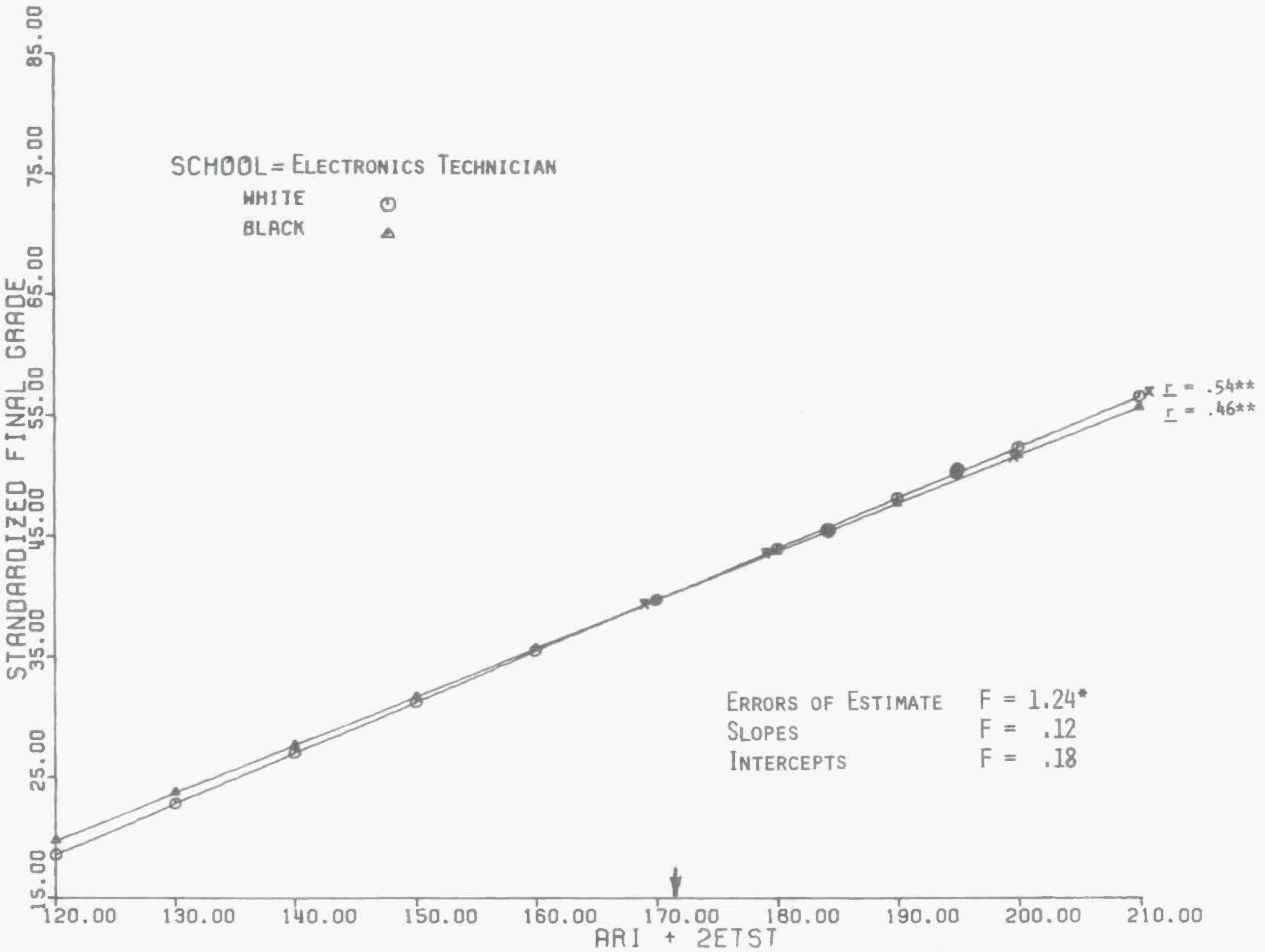
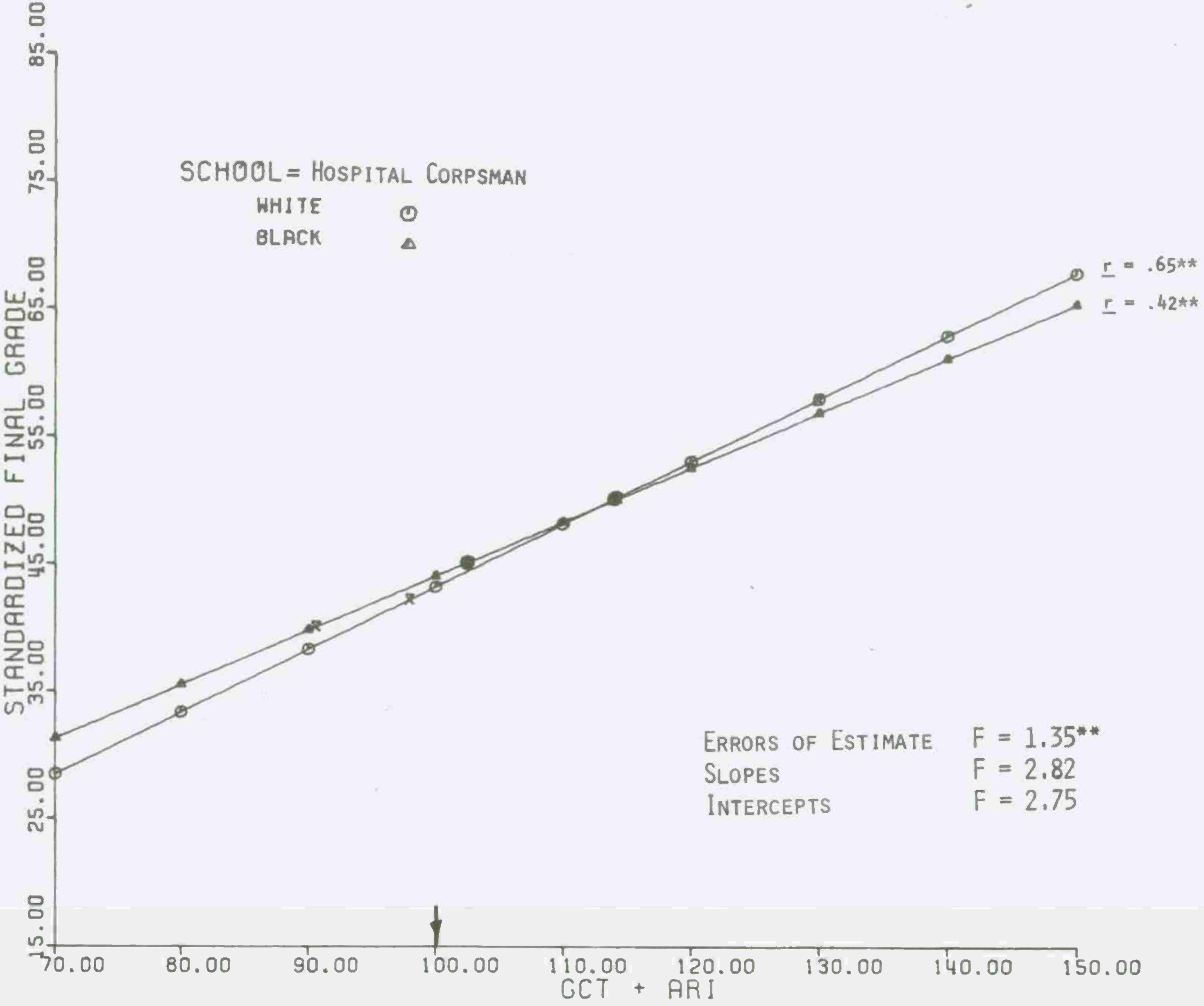
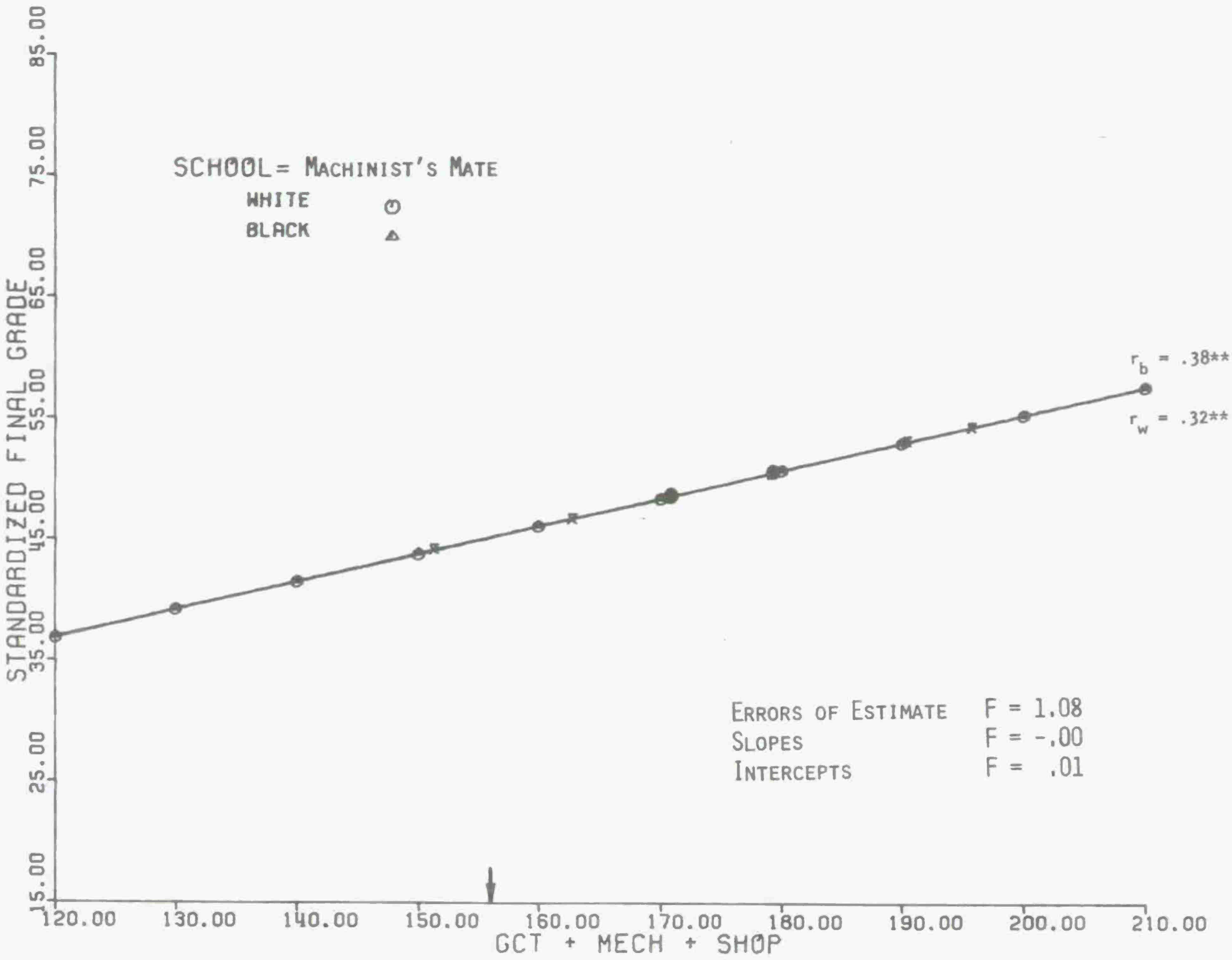
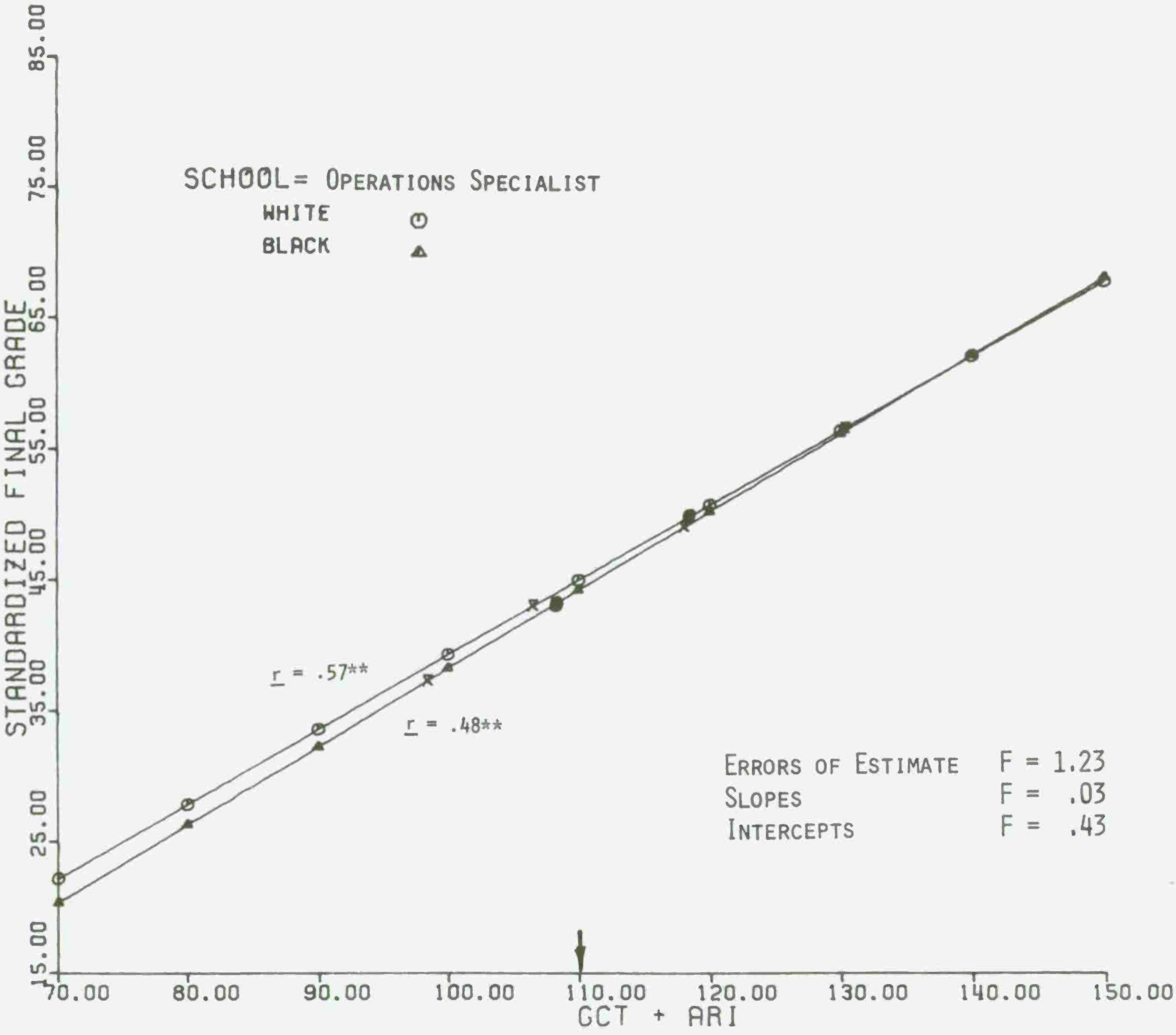
WHITE
BLACK
r = .63**
r = .42**
ERRORS OF ESTIMATE F = 1.51
SLOPES F = .73
INTERCEPTS F = 1.97
STANDARDIZED FINAL GRADE
GCT + MECH + SHOP
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00


SCHOOL = ELECTRONICS TECHNICIAN
WHITE
BLACK
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
ARI + 2ETST
r = .54**
r = .46**
ERRORS OF ESTIMATE F = 1.24*
SLOPES F = .12
INTERCEPTS F = .18


SCHOOL= HOSPITAL CORPSMAN
WHITE
BLACK
r = .65**
r = .42**
ERRORS OF ESTIMATE F = 1.35**
SLOPES F = 2.82
INTERCEPTS F = 2.75
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00
GCT + ARI


SCHOOL= MACHINIST'S MATE
WHITE
BLACK
STANDARDIZED FINAL GRADE
85.00
75.00
65.00
55.00
45.00
35.00
25.00
15.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00
190.00
200.00
210.00
GCT + MECH + SHOP
r_b = .38**
r_w = .32**
ERRORS OF ESTIMATE F = 1.08
SLOPES F = -.00
INTERCEPTS F = .01



SCHOOL= OPERATIONS SPECIALIST
WHITE
BLACK
r = .57**
r = .48**
ERRORS OF ESTIMATE F = 1.23
SLOPES F = .03
INTERCEPTS F = .43
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
70.00
80.00
90.00
100.00
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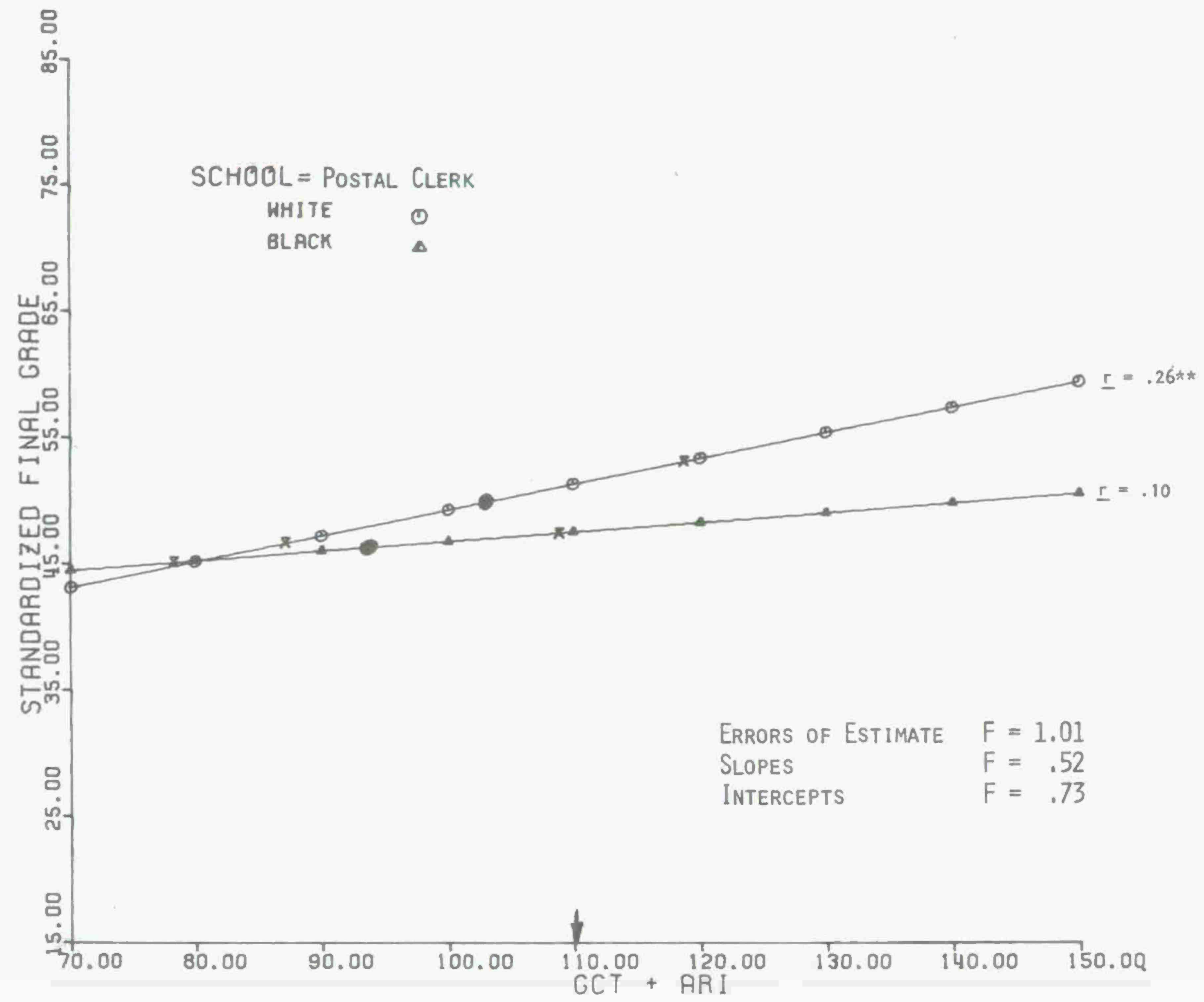
120.00
130.00
140.00
150.00
GCT + ARI


SCHOOL = POSTAL CLERK
WHITE
BLACK
r = .26**
r = .10
ERRORS OF ESTIMATE F = 1.01
SLOPES F = .52
INTERCEPTS F = .73
STANDARDIZED FINAL GRADE
GCT + ARI
15.00
25.00
35.00
45.00
55.00
65.00
75.00
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70.00
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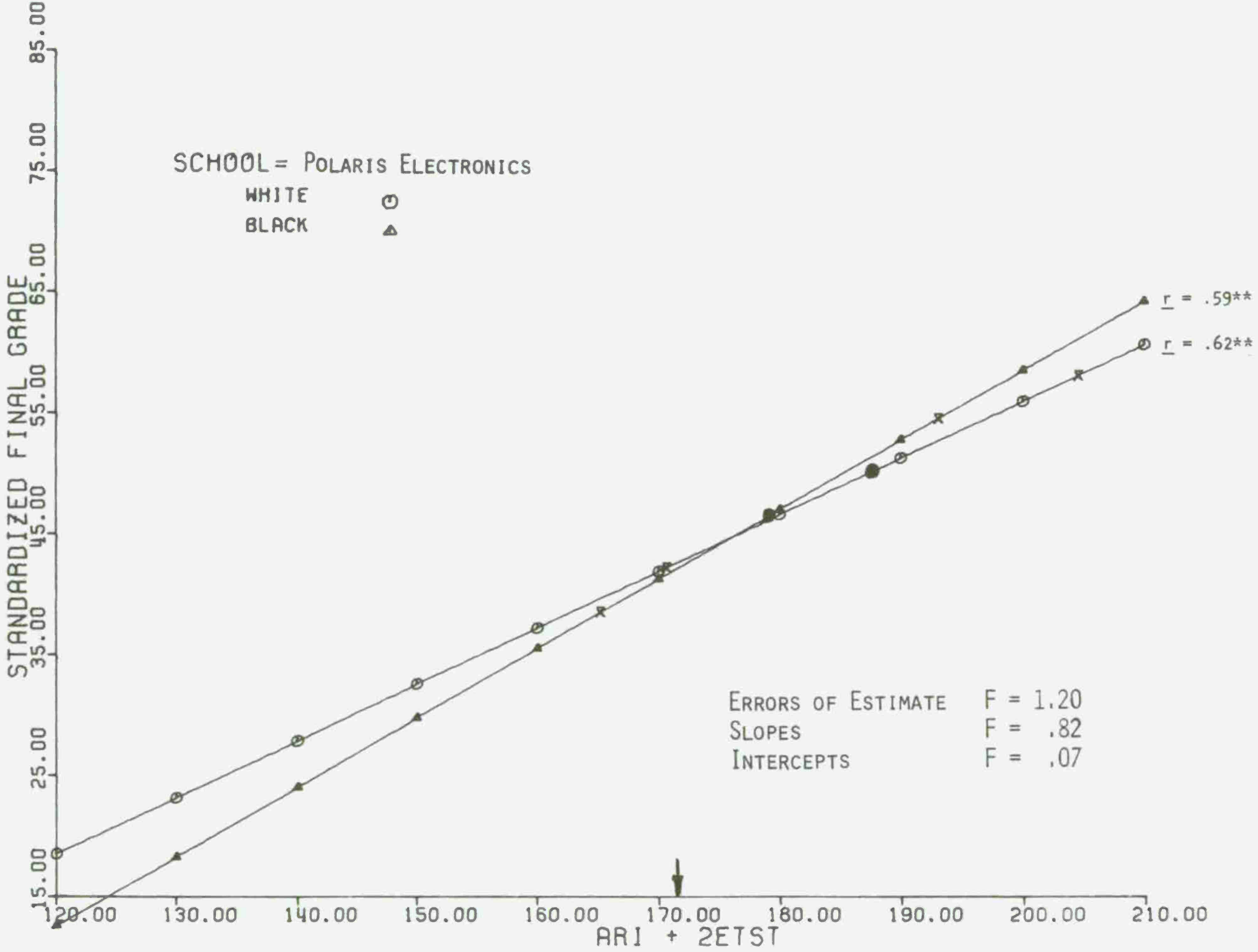
SCHOOL = POLARIS ELECTRONICS
WHITE
BLACK
r = .59**
r = .62**
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
120.00
130.00
140.00
150.00
160.00
170.00
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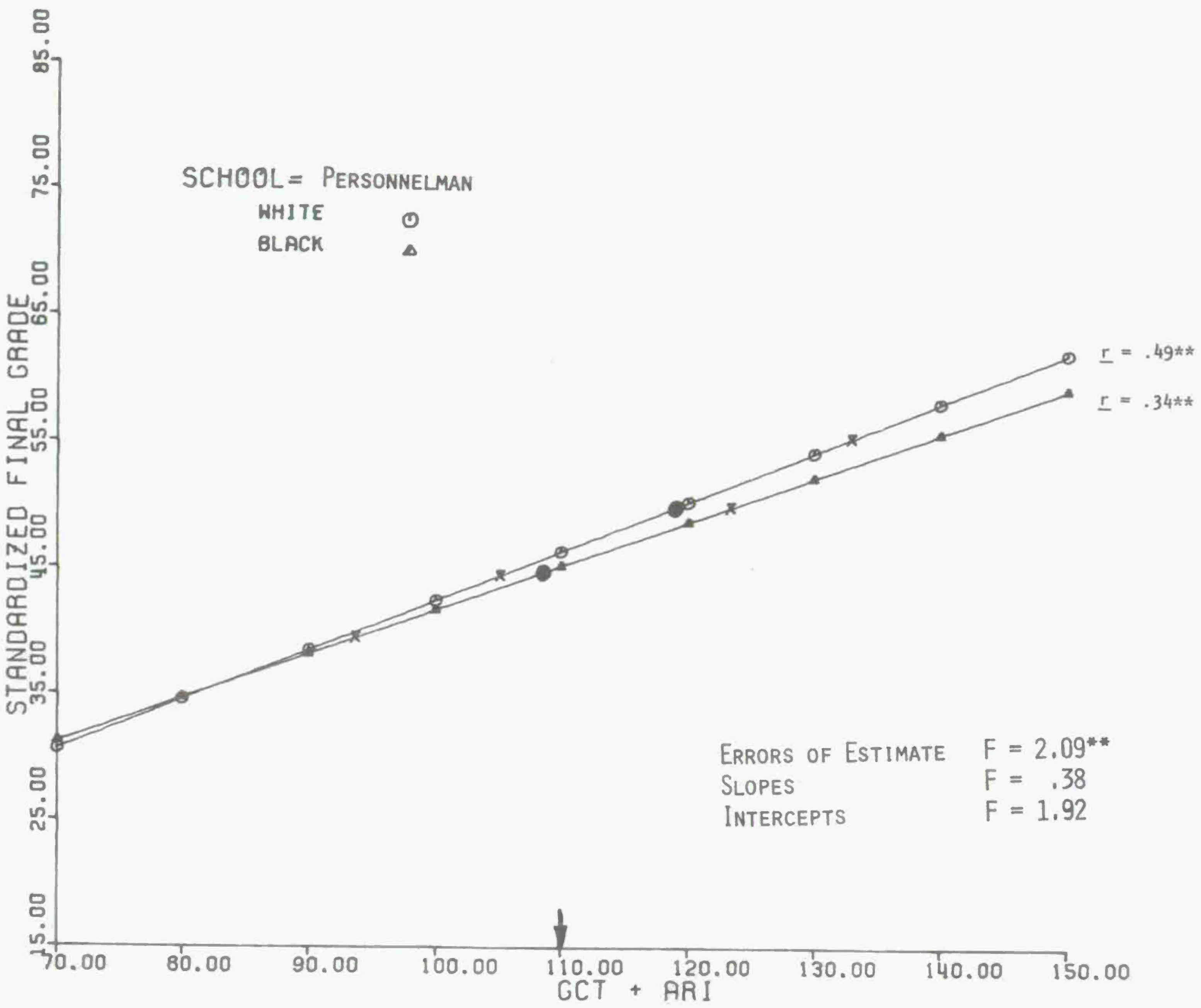
210.00
ARI + 2ETST
ERRORS OF ESTIMATE F = 1.20
SLOPES F = .82
INTERCEPTS F = .07


SCHOOL= PERSONNELMAN
WHITE
BLACK
r = .49**
r = .34**
ERRORS OF ESTIMATE F = 2.09**
SLOPES F = .38
INTERCEPTS F = 1.92
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
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90.00
100.00
110.00
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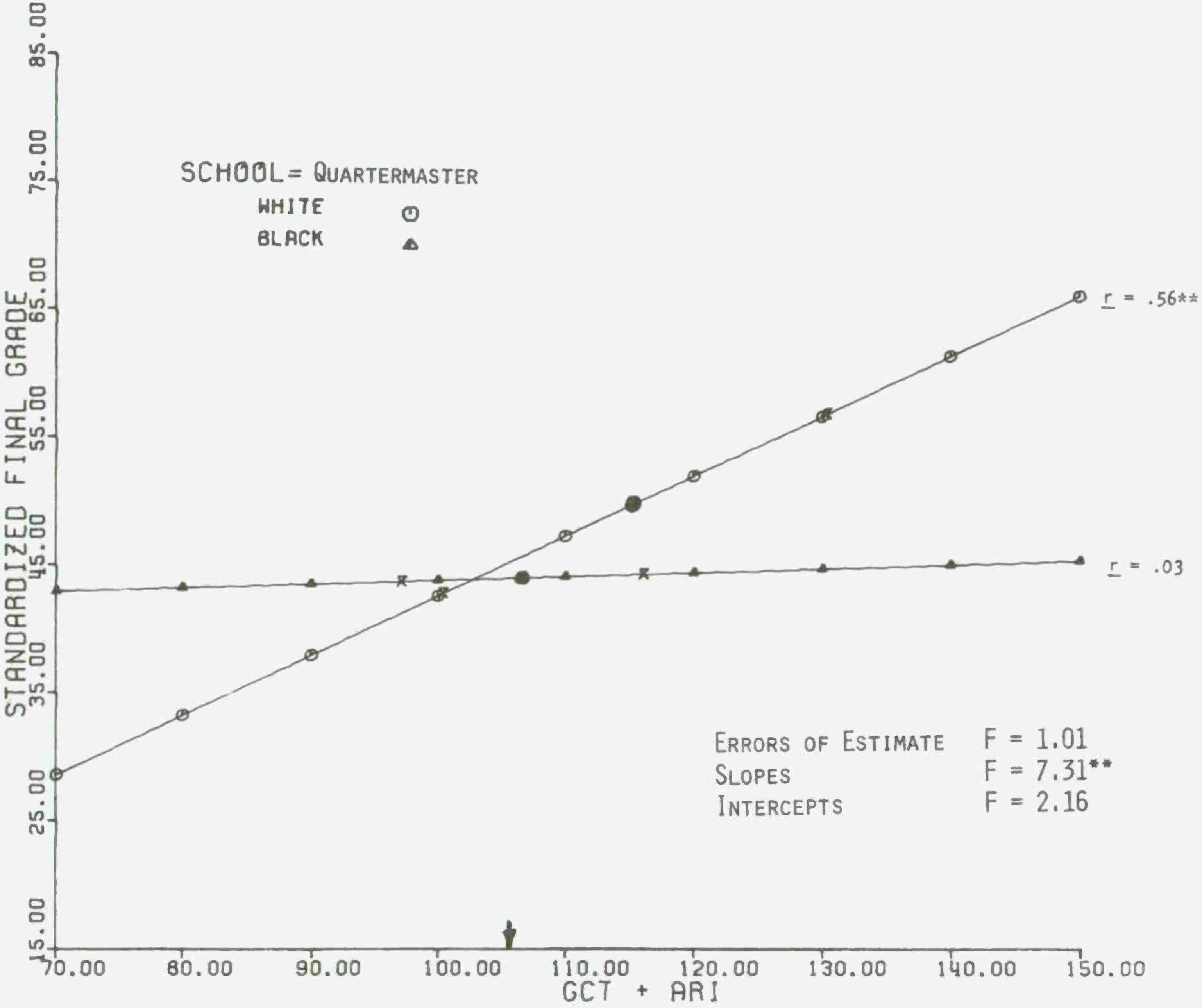
140.00
150.00
GCT + ARI


SCHOOL= QUARTERMASTER
WHITE
BLACK
r = .56**
r = .03
ERRORS OF ESTIMATE F = 1.01
SLOPES F = 7.31**
INTERCEPTS F = 2.16
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
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110.00
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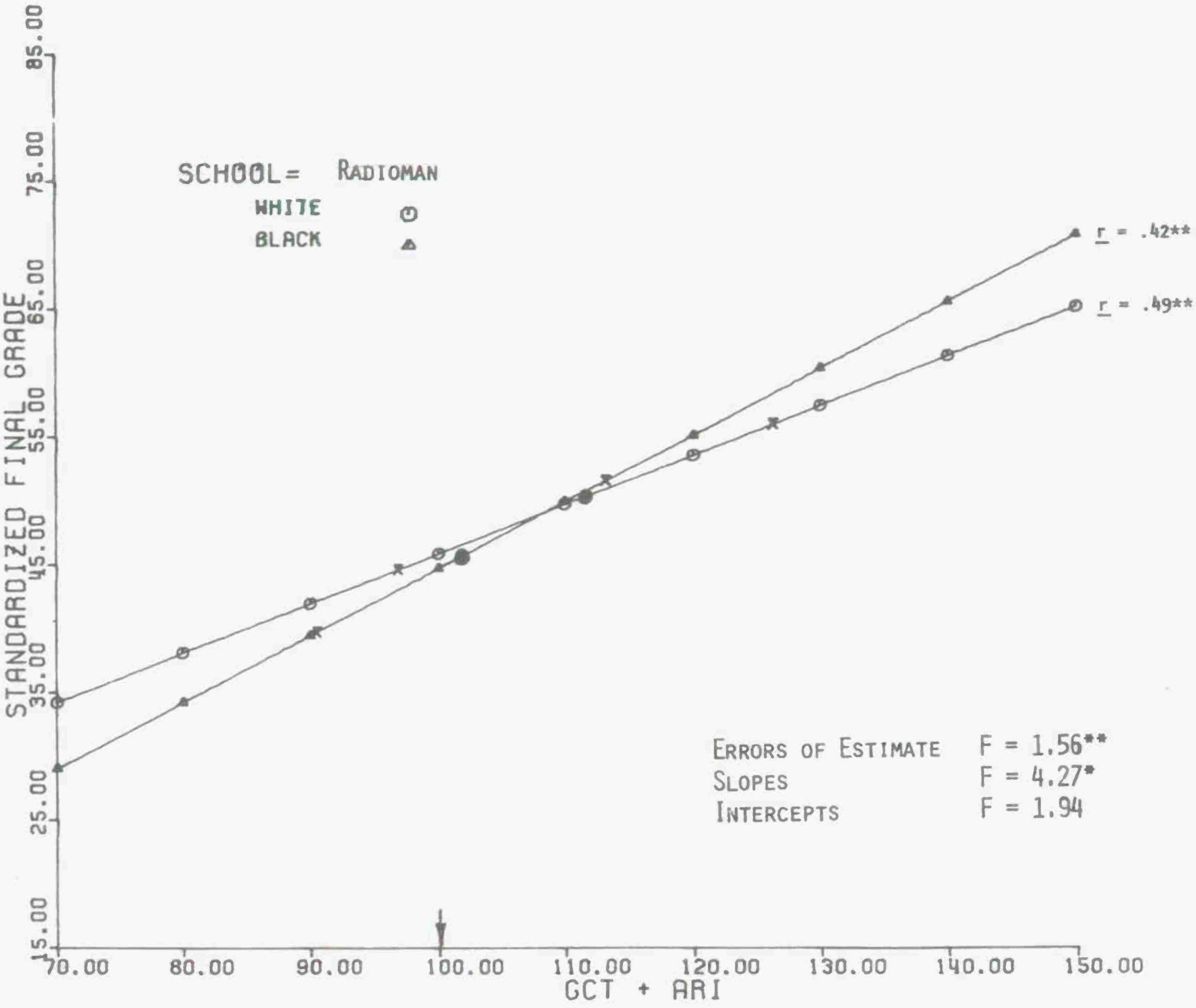
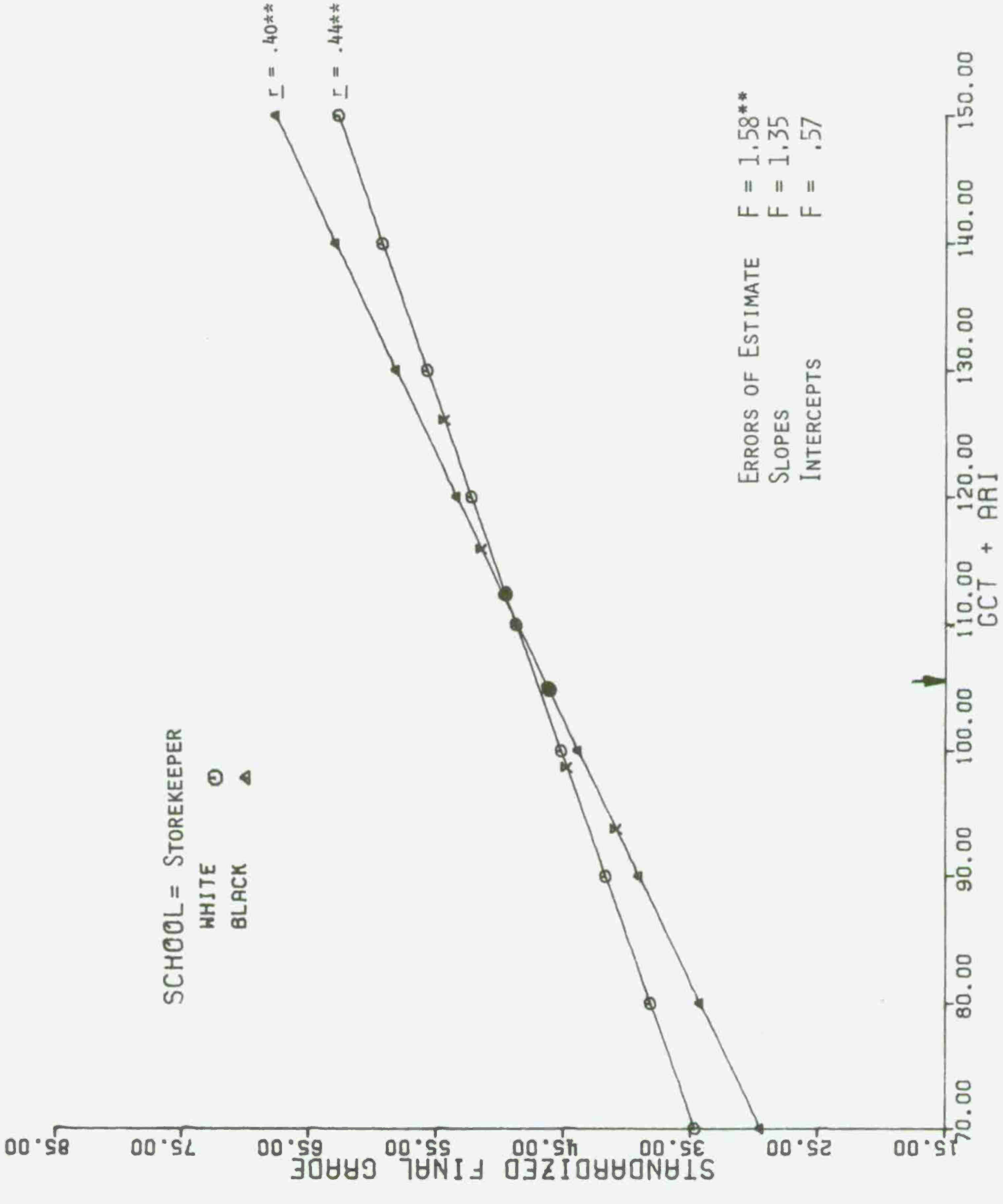
140.00
150.00
GCT + ARI


SCHOOL= RADIOMAN
WHITE
BLACK
r = .42**
r = .49**
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00
GCT + ARI
ERRORS OF ESTIMATE F = 1.56**
SLOPES F = 4.27*
INTERCEPTS F = 1.94



SCHOOL= STOREKEEPER
WHITE
BLACK
r = .40**
r = .44**
ERRORS OF ESTIMATE F = 1.58**
SLOPES F = 1.35
INTERCEPTS F = .57
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
GCT + ARI
70.00
80.00
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130.00
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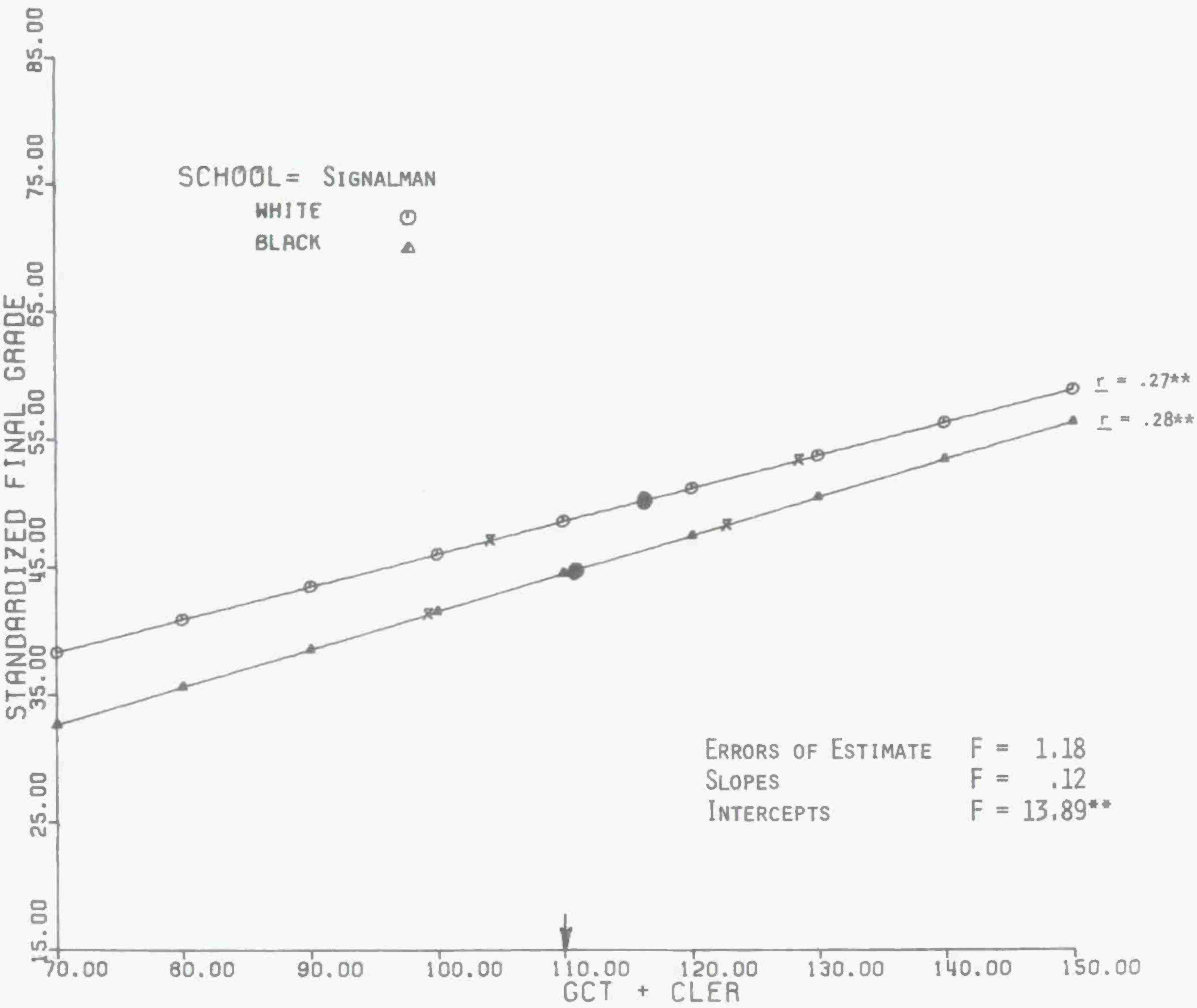
150.00


SCHOOL= SIGNALMAN
WHITE
BLACK
r = .27**
r = .28**
ERRORS OF ESTIMATE F = 1.18
SLOPES F = .12
INTERCEPTS F = 13.89**
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
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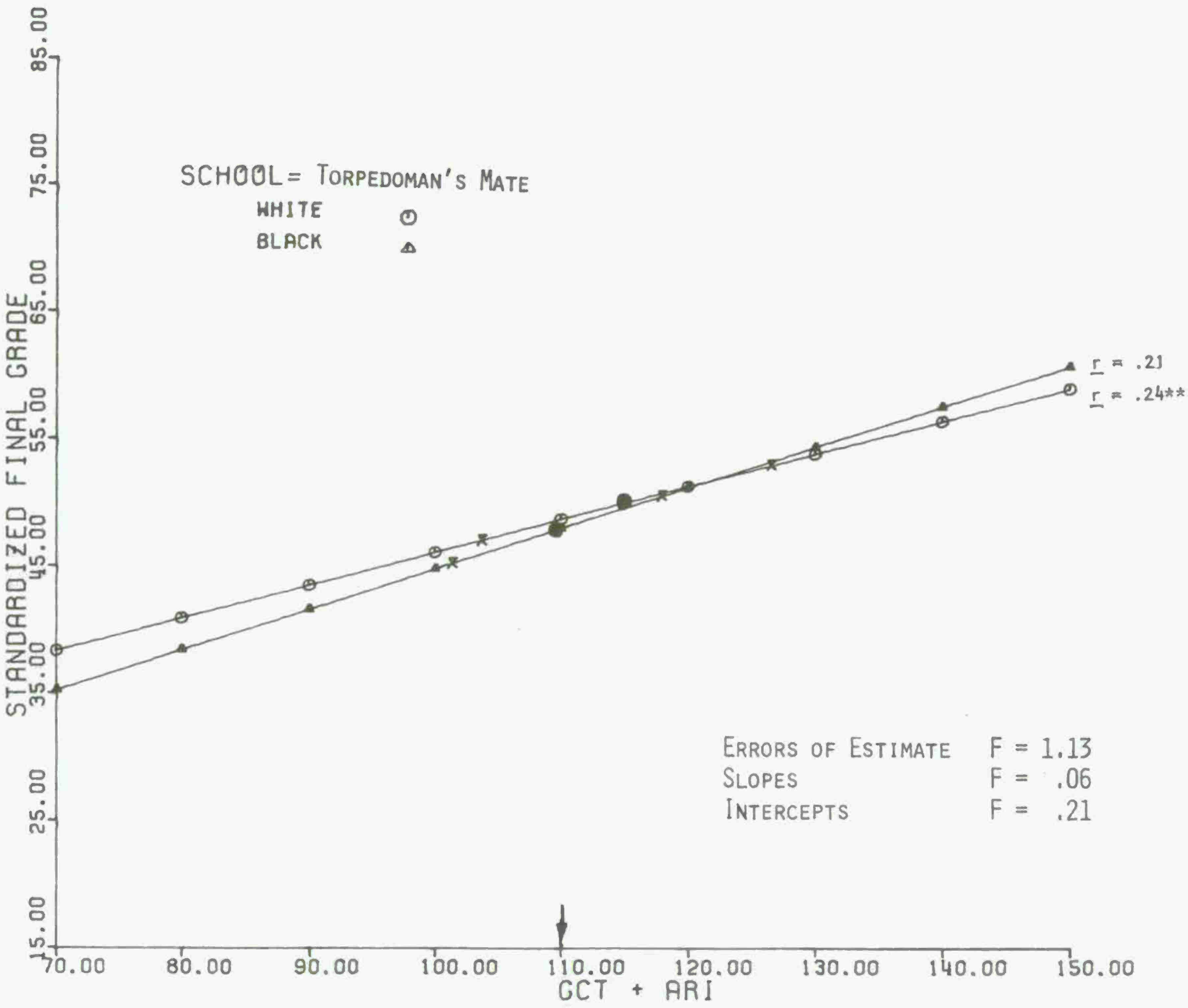
140.00
150.00
GCT + CLER


SCHOOL= TORPEDOMAN'S MATE
WHITE
BLACK
STANDARDIZED FINAL GRADE
GCT + ARI
r = .21
r = .24**
ERRORS OF ESTIMATE F = 1.13
SLOPES F = .06
INTERCEPTS F = .21
15.00
25.00
35.00
45.00
55.00
65.00
75.00
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130.00
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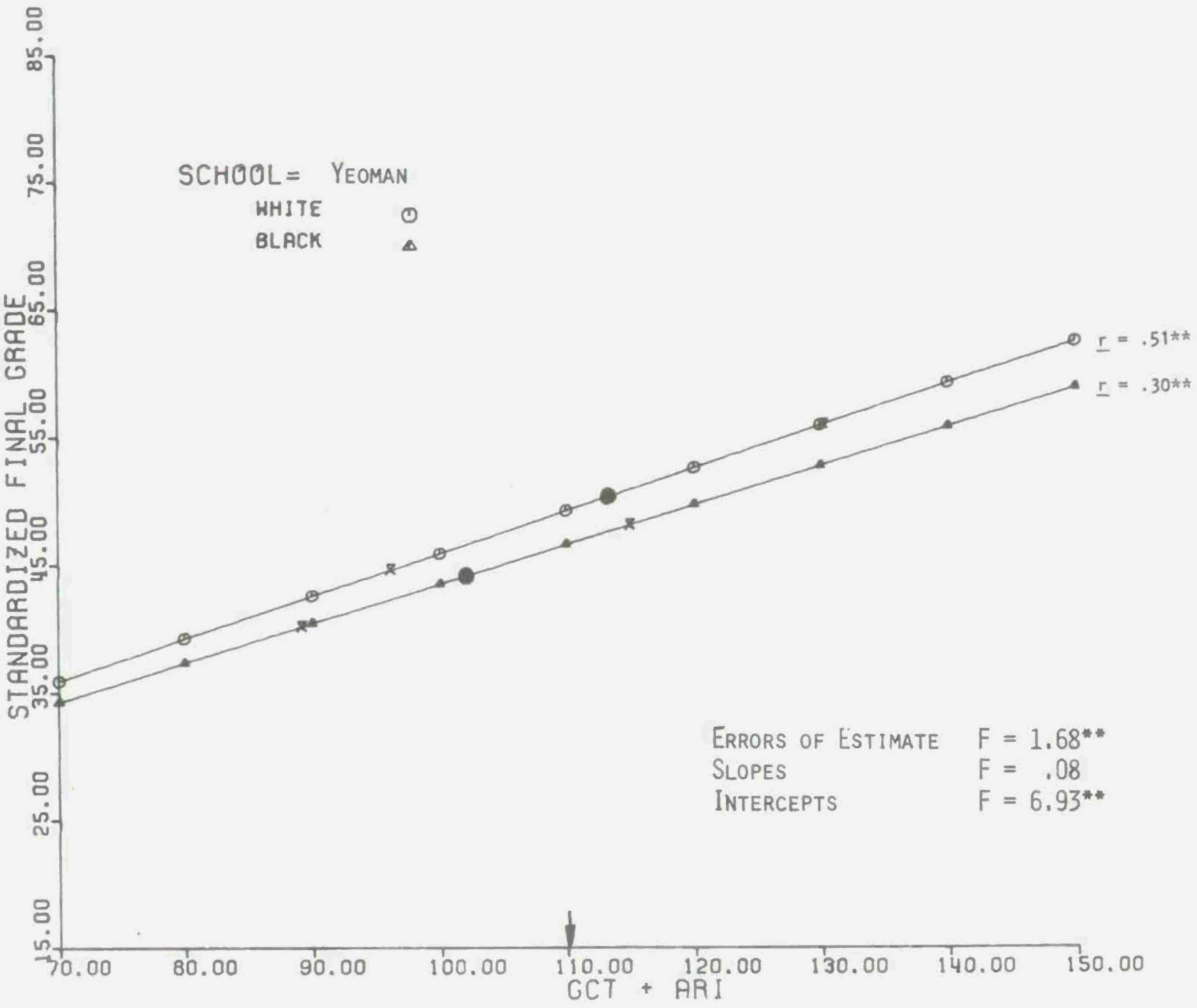
150.00



SCHOOL= YEOMAN
WHITE
BLACK
r = .51**
r = .30**
ERRORS OF ESTIMATE F = 1.68**
SLOPES F = .08
INTERCEPTS F = 6.93**
STANDARDIZED FINAL GRADE
15.00
25.00
35.00
45.00
55.00
65.00
75.00
85.00
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00
GCT + ARI

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